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REVIVING EXTINCT SPECIES

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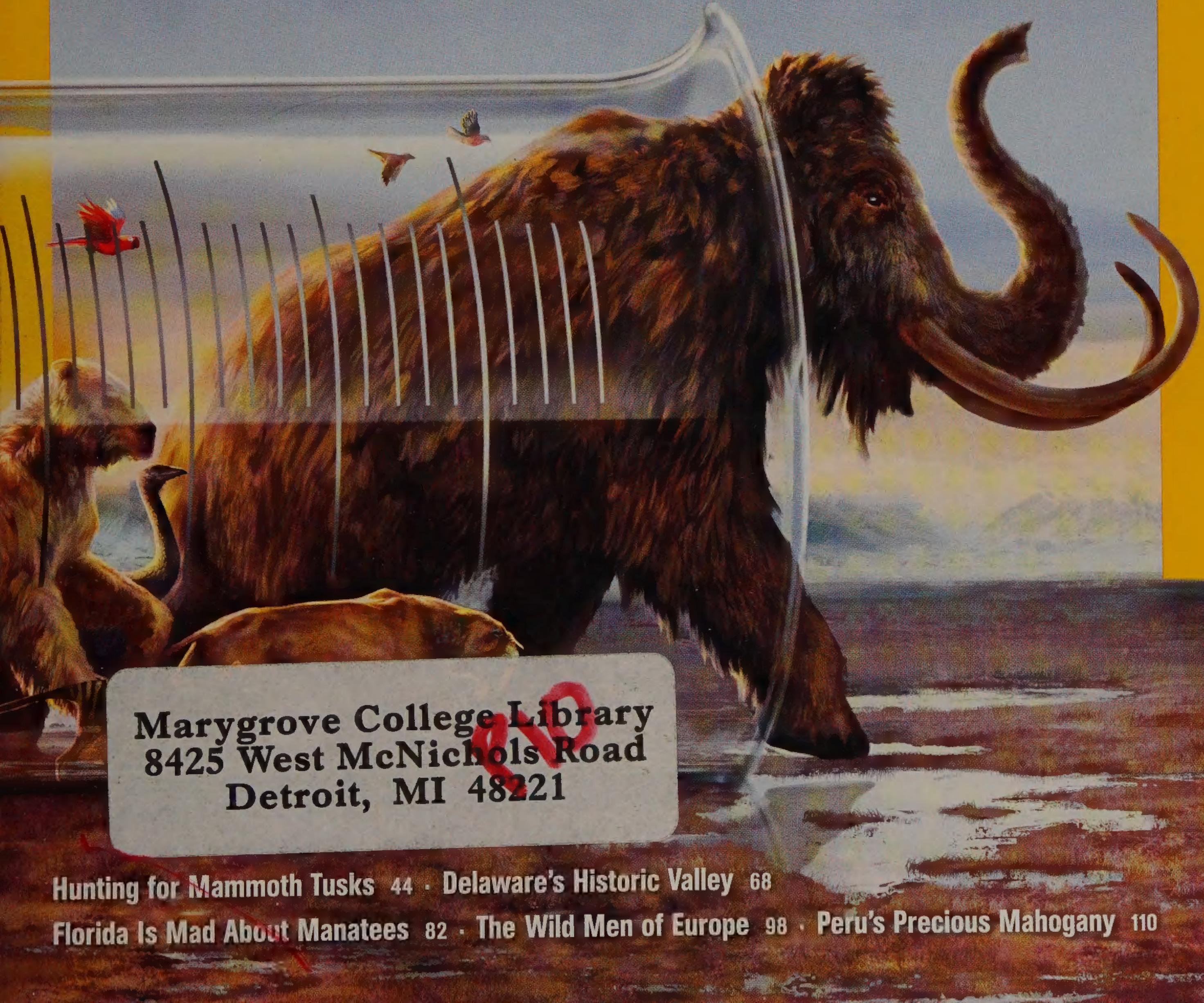

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Hunting for Mammoth Tusks 44 · Delaware's Historic Valley 68

Florida Is Mad About Manatees 82 · The Wild Men of Europe 98 · Peru's Precious Mahogany 110

Indian Ocean
Mozambique Channel
MADAGASCAR

Amber Mountain Rock Thrush *(Monticola erythronotus)*
Size: Head and body length, approx. 16 cm (6.3 inches) **Weight:** Unknown **Habitat:** Montane forest on the Amber Mountain massif in northern Madagascar **Surviving number:** Estimated at fewer than 5,000

Photographed by Will Burrad-Lucas

WILDLIFE AS CANON SEES IT

Living small. For the Amber Mountain rock thrush, the world it knows is remarkably limited—restricted to a solitary block of forest on a single mountain in Madagascar. In fact, its entire home range is half the size of New York City. Foraging on the ground and understory of this tiny domain, the thrush seeks out a variety of terrestrial and aerial prey. It then returns to its nest, built in tree hollows beneath overhangs or among tree fern and pandanus leaves. But the "island" of forest that provides its food and shelter faces the very big threat of habitat loss in a country where less than 10% of the original forest remains.

As we see it, we can help make the world a better place. Raising awareness of endangered species is just one of the ways we at Canon are taking action—for the good of the planet we call home. Visit **canon.com/environment** to learn more.

Canon

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VOL. 223 • NO. 4

NATIONAL GEOGRAPHIC

"Why, they don't look like nothin' at all!" a woman exclaims. She has a point.
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April 2013

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Reviving an extinct species is no longer a fantasy. Is it a good idea?
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They dress in bear heads and bells, and behave like beasts.
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Illegal loggers plunder Peru's forests for mahogany.
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Worn on Mardi Gras, this toothy Italian costume may have been inspired by dragons. The hiking boots are optional. CHARLES FRÉGER

April 2013

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Healing the Ozone Layer
Getting rid of CFCs in spray cans and coolants was a good move.

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Research shows that an air-bag-like device can save lives.

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Lead tablets inscribed with ancient Roman curses are being unearthed.

Ptooey, Ptooey ▸
That remark is one way to foil the evil eye. There are others…involving eyes.

Who's Outliving Whom
On average, U.S. women still live longer than men, but guys are catching up.

Add Zing to the Strings
Introducing fungi into a violin's wood can bring it up to Stradivarius caliber.

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The Moment
Flashback

On the Cover Gone but not forgotten, these animals may live again: from left, giant sloth, Cuban red macaw, New Zealand giant moa, Tasmanian tiger, saber-toothed cat, two passenger pigeons, dodo, woolly mammoth.
Art by Jon Foster

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Learn how average life spans vary by U.S. county.

Tusk Hunters
Video
Follow the quest for mammoth ivory in Siberia.

NATIONAL GEOGRAPHIC CHANNEL

Mammoth:
Back From the Dead
Scientists attempt to clone the extinct behemoth; airs April 12 at 8 p.m.

PHOTOS: MAXIM ARBUGAEVA (MIDDLE); LOVE DALÉN, CB FILMS

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Resurrection

The idea of "de-extinction," of bringing back a long-gone species like, say, a woolly mammoth, might seem the stuff of science fiction. But it's almost real, explains author Carl Zimmer in this month's story "Bringing Them Back to Life." The cool factor of such a zoological restoration is off the charts, but de-extinction also raises some interesting questions about human beings and our impact on the world. Many extinctions occur because of our thoughtlessness or carelessness. We want a better life. We want to make the unhabitable habitable. We want to fill our stomachs. Sometimes what gets caught in the cross fire of our wants is a species. You could say an extinct species is the collateral damage of human existence. Just because we might be able to bring an extinct species back to life, though, doesn't mean we should. There's always the law of unintended consequences to contend with. One example: An errant virus harbored in one of these creatures might wipe out the population of a related species. On the other hand, bringing back a species might put an ailing ecosystem on a healthier footing. It could right an ecological wrong.

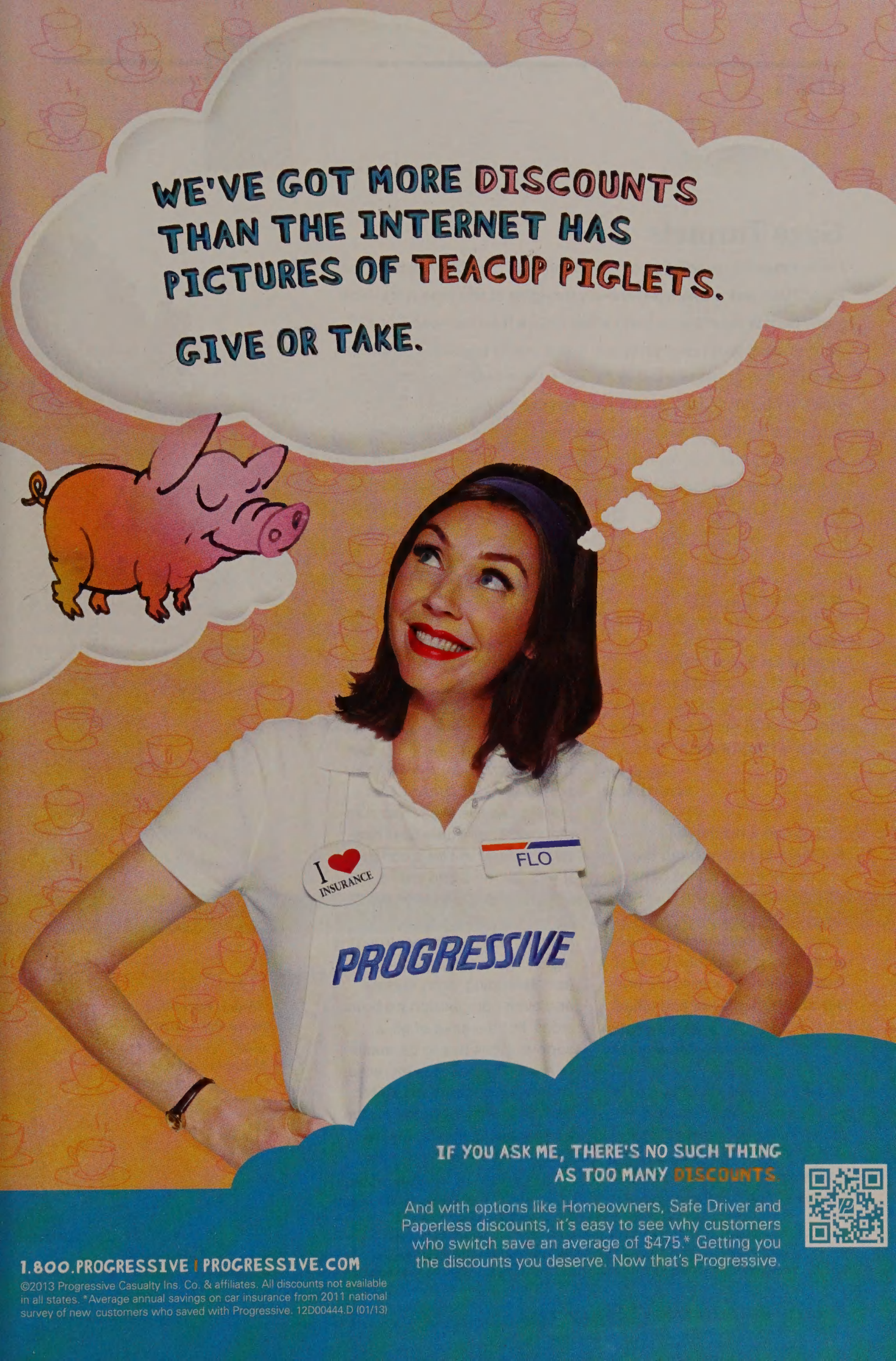
These scientists involved in de-extinction efforts gathered for the first time at National Geographic Society headquarters this past October. Along with ethicists and conservationists, they brought the issue before the public at a March 15 TEDx conference, also at National Geographic. Hear what they have to say in our digital editions.

SCIENTISTS: MICHAEL ARCHER, INSUNG HWANG, HANK GREELY (TOP ROW); STEWART BRAND, MARILYN RENFREE, MICHAEL MCGREW (MIDDLE); BEN NOVAK, GEORGE CHURCH (BOTTOM). PHOTOS: SPENCER MILLSAP

It could right an ecological wrong.

So what's the answer? Is the restoration of an extinct species a moral obligation, a payback for our thoughtless obliteration of species? Or is it playing God? As Ross MacPhee, a curator of mammalogy at New York City's American Museum of Natural History, said: "What we really need to think about is why we would want to do this in the first place."

Chris Johns



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December 2012

Gaza Tunnels

I remember first reading about the conflict in the Middle East in the early '70s. I was a teenager, and my thoughts at the time were: How many people must be hurt and killed before this madness stops? After reading your powerful article, I was sick to my stomach thinking about a 12-year-old boy losing his sight. Who cares anymore who started this ridiculous war? It's time to stop it, although I have no illusions that this will occur in my lifetime. It has been almost 40 years since I was first exposed to the "conflict in the Middle East." Will there ever be room in Israel for both sides to live in peace?

BEVERLY BOKOVITZ
Medina, Ohio

Israel and Egypt treat the Palestinians like insects. It is no surprise that they should bore into the earth like insects to survive. This is a hallmark of the slow genocide being committed against these people. It is time for some basic human rights.

KIM ACCO
Laval, Quebec

You turned a blind eye to the really big story about the tunnels—the thousands of missiles and launchers that were disassembled, hauled through them, then reassembled in Gaza so that they could then be shot indiscriminately across the border at Israeli villages and cities.

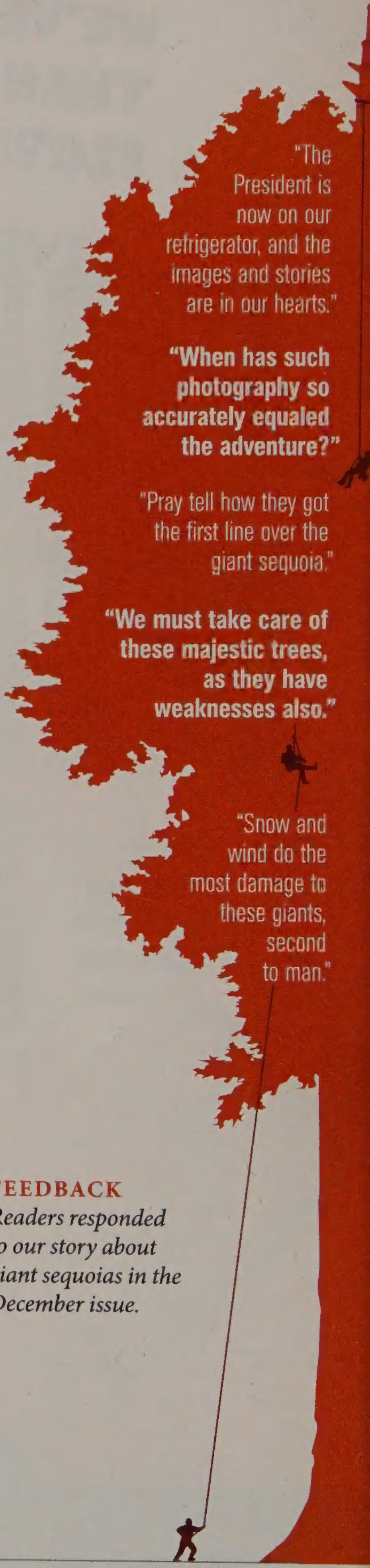
JONATHAN DAVIS
Brookline, Massachusetts

While the article on the tunnels of Gaza could not have been more timely, the current reality shows that the tunnels are an integral part of Hamas's war machine. The tunnels allowed delivery of the parts to assemble the missiles that rain down upon Israel's civilian population, prompting the cycles of violence.

SCOTT DAVID LIPPE
Fair Lawn, New Jersey

It is a disgrace for the civilization of the 21st century that people can live in such circumstances. The Middle East has been, is, and will be a constant threat for the world until a peaceful solution takes place there. The peace cannot be maintained on military strengths alone. The solution requires understanding, compromise, and even compassion on both sides. For the sake of all, a serious effort has to be made to reach the peace; otherwise, so many innocents will suffer and die in vain for nothing. I am a Holocaust survivor. Do we not ever learn from the past?

ROBERT FISCH
Minneapolis, Minnesota

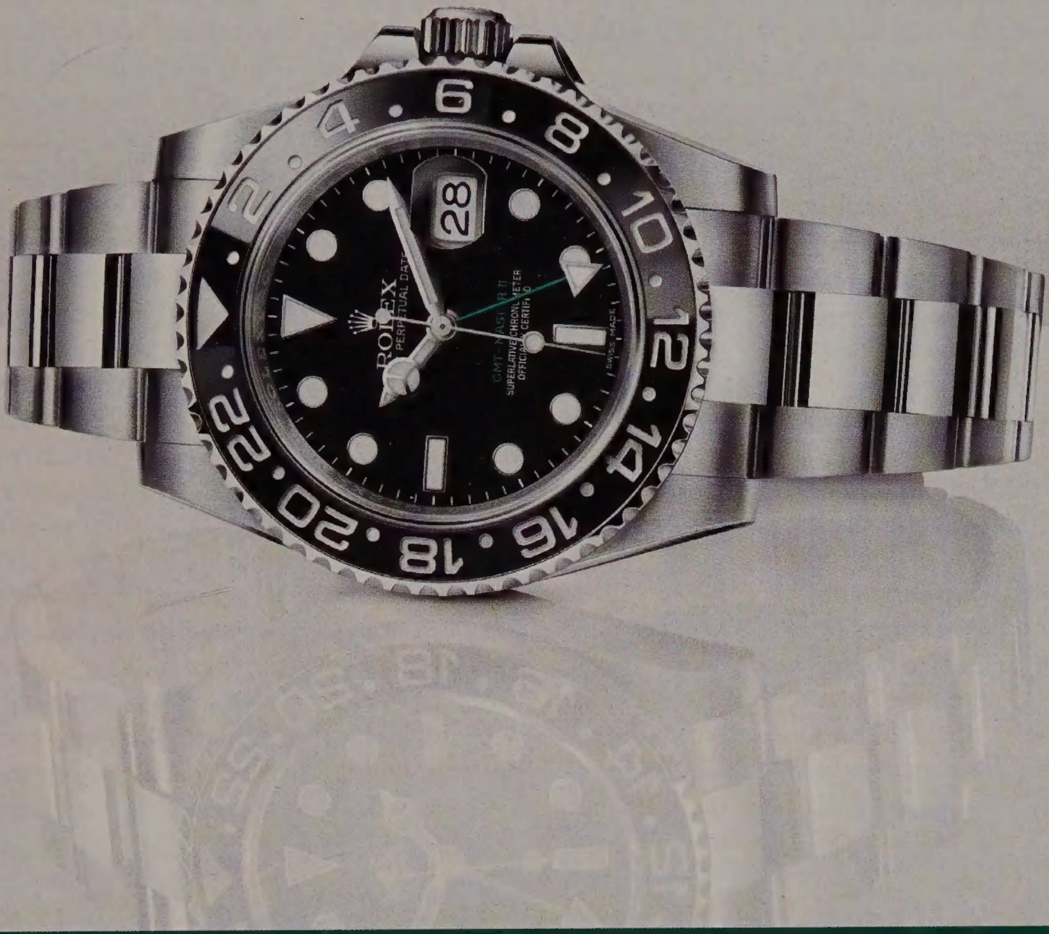

"The President is now on our refrigerator, and the images and stories are in our hearts."
"When has such photography so accurately equaled the adventure?"
"Pray tell how they got the first line over the giant sequoia."
"We must take care of these majestic trees, as they have weaknesses also."
"Snow and wind do the most damage to these giants, second to man."

FEEDBACK

Readers responded to our story about giant sequoias in the December issue.

EMAIL ngsforum@ngm.com **TWITTER** @NatGeoMag **WRITE** National Geographic Magazine, PO Box 98199, Washington, DC 20090-8199. Include name, address, and daytime telephone. Letters may be edited for clarity and length.

GRAPHIC: MAAYAN HAREL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Methane

Marianne Lavelle's comprehensive, balanced, and excellent article neglected to mention the typical hours for hydrofracking industry workers—12 hours a day, seven days a week, for two weeks straight. Until the federal and state governments limit hours, overly tired workers will make errors, causing needless harm to the environment, to neighbors, and to themselves.

JONATHAN STRONG
Endicott, New York

Having worked in the energy industry for 25-plus years, I would like to point out that not only does natural gas emit just about half the CO_2 of coal, but in new gas-fired power plants (combustion turbine combined cycles), the gas is also burned at more than 50 percent efficiency, compared with about 35 percent efficiency in coal plants.

STANLEY VEJTASA
Roseburg, Oregon

We must halt this fracking boom to safeguard our climate.

Gas fracking's methane pollution threatens our climate, but oil fracking poses a huge additional danger by prying open deposits of previously inaccessible high-carbon fuel. In California, fracking the Monterey Shale—a formation that holds about 14 billion barrels of frackable oil—will light the fuse on a carbon bomb that will shatter our state's efforts to fight global warming. We must halt this fracking boom to safeguard our climate—and our children's future.

KASSIE SIEGEL
Director, Climate Law Institute
Joshua Tree, California

Giant Sequoias

The excellent article about the giant sequoia left me with a question: What about its root system? I wish the team had extended their research belowground and continued the illustration on page 36 downward. How deep do the roots go? How far outward do they stretch? What portion of the total mass are they?

RON KAISER
Del Mar, California

Sequoia scientist Steve Sillett responds that the problem is how to do root measurements without hurting the tree. So far there are no reliable solutions—so no data.

Your article on the sequoias reminds me that these trees were already 1,000 years old at the time of Christ. And they have continued to thrive for 2,000 years more—a remarkable example of adapting to a natural environment.

JOHN JOHNSON
Albuquerque, New Mexico

I was delighted to get the December issue with the cover story on sequoias. I saved the October 2009 cover story on redwoods and will add this to my collection. The next vacation I am planning will be a "tree tour" of California to see the tallest (redwood), largest (sequoia), and oldest (bristlecone pine) trees. I can only hope (and beg) that you will complete your series with the bristlecone pine and help me finish my trip preparation.

ELIZABETH BUCHEN
Albuquerque, New Mexico

David Quammen ends this wonderful article by mentioning that giant sequoias are too bulky to sway in the wind. Allow me to correct that notion. On an afternoon excursion to Redwood Mountain, a powerful rotor windstorm came up rather suddenly. I happened to observe these kingly giants surrounding the parking lot swaying most visibly. The windy din with the sight of these monumental trees swaying was exhilarating and rather frightening—and clearly memorable. So yes, they do sway—rarely, but magnificently.

CHRIS GLENN
Badger, California

FLASHBACK: Sequoia

My grandfather, Robert Foss, on vacation from Pasadena, conceived the idea of building a ramp that allowed him to get his auto and camping gear on top of the fallen sequoia for a photo. He is pictured sitting in front of the tent. My grandmother, Mae Foss, is at the table, and their daughter, Evelyn—my mother—is the young lady on the log. The photo was used in advertising for the Southern Pacific Railway. Thanks for bringing happy memories of loved ones.

DORIS McANDREW
Fargo, North Dakota

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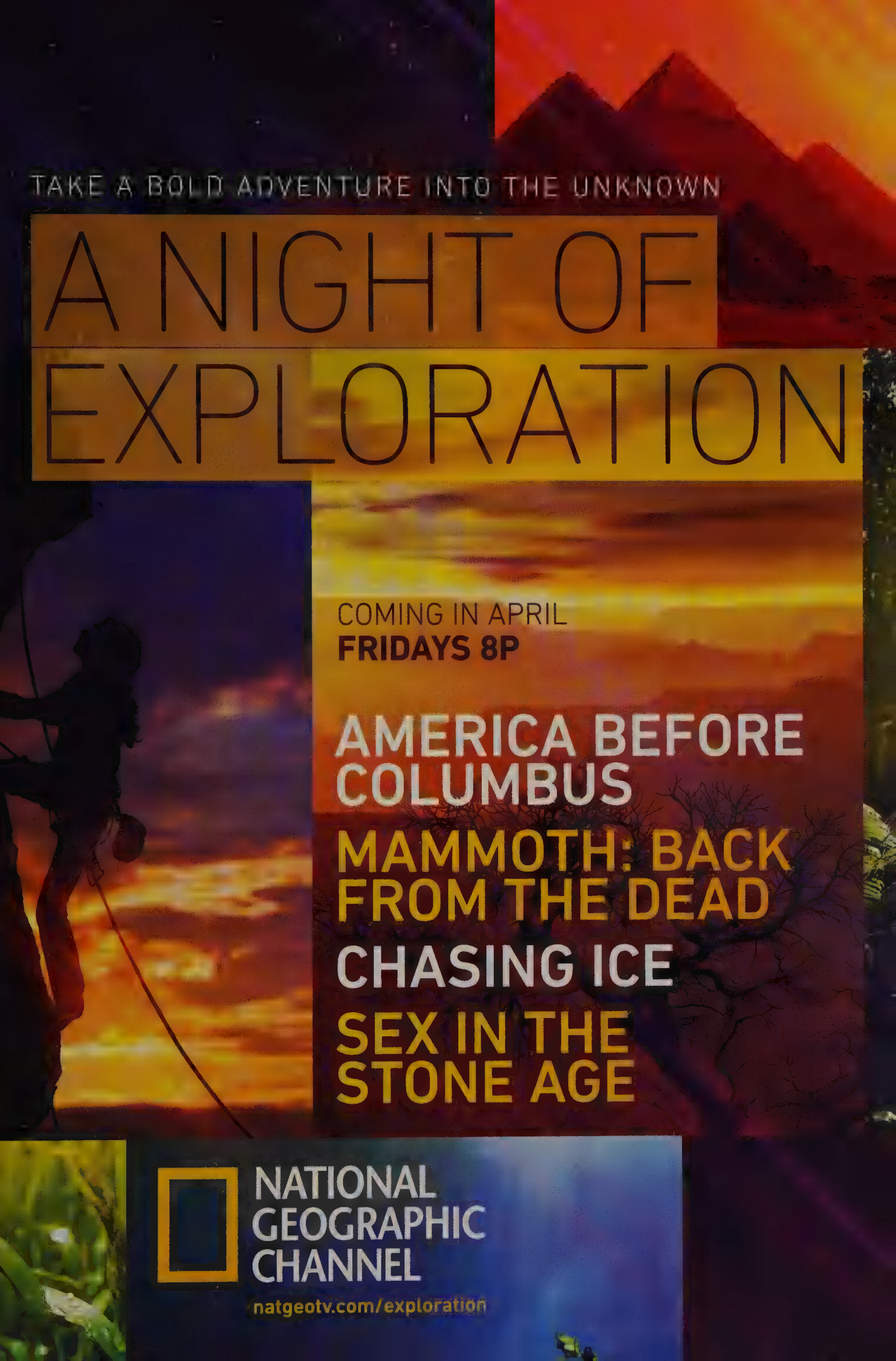
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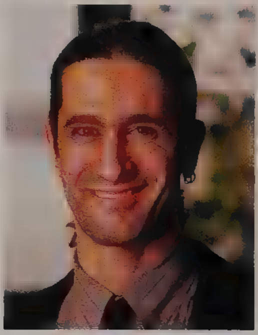


Agustín Fuentes
National Geographic
Grantee

EXPERTISE
Primatologist

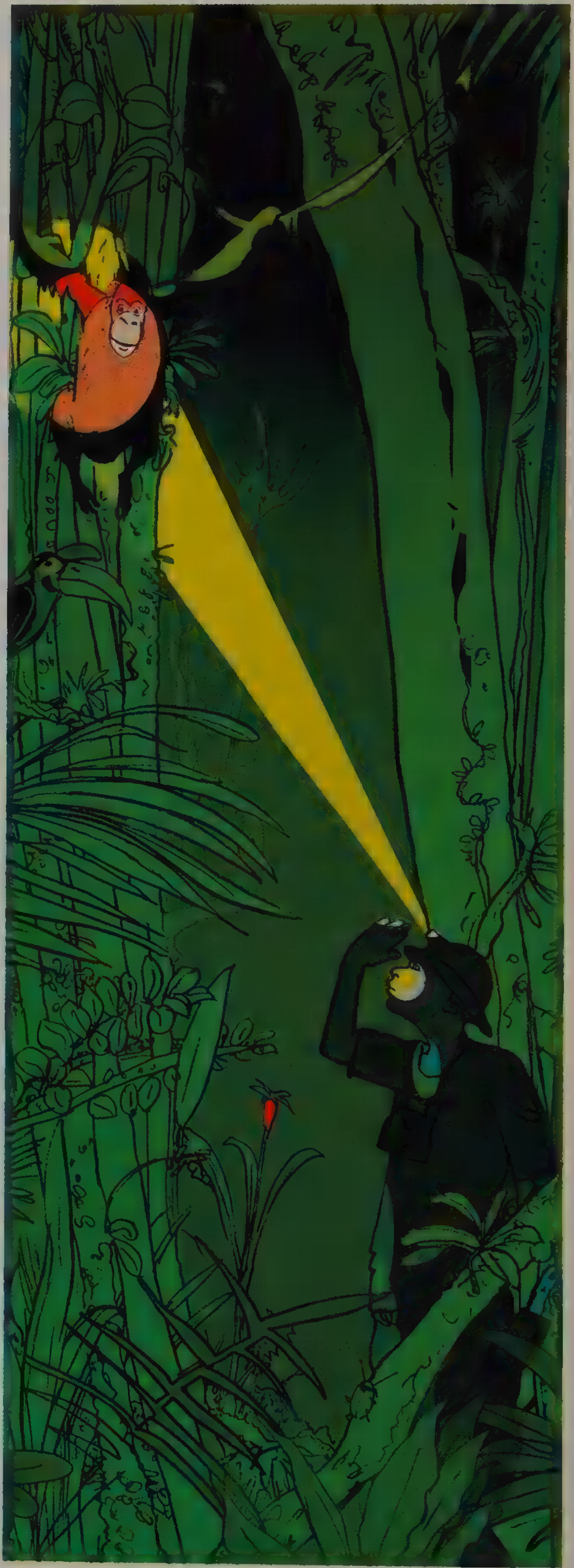
LOCATION
Borneo

Orangutan to the Rescue

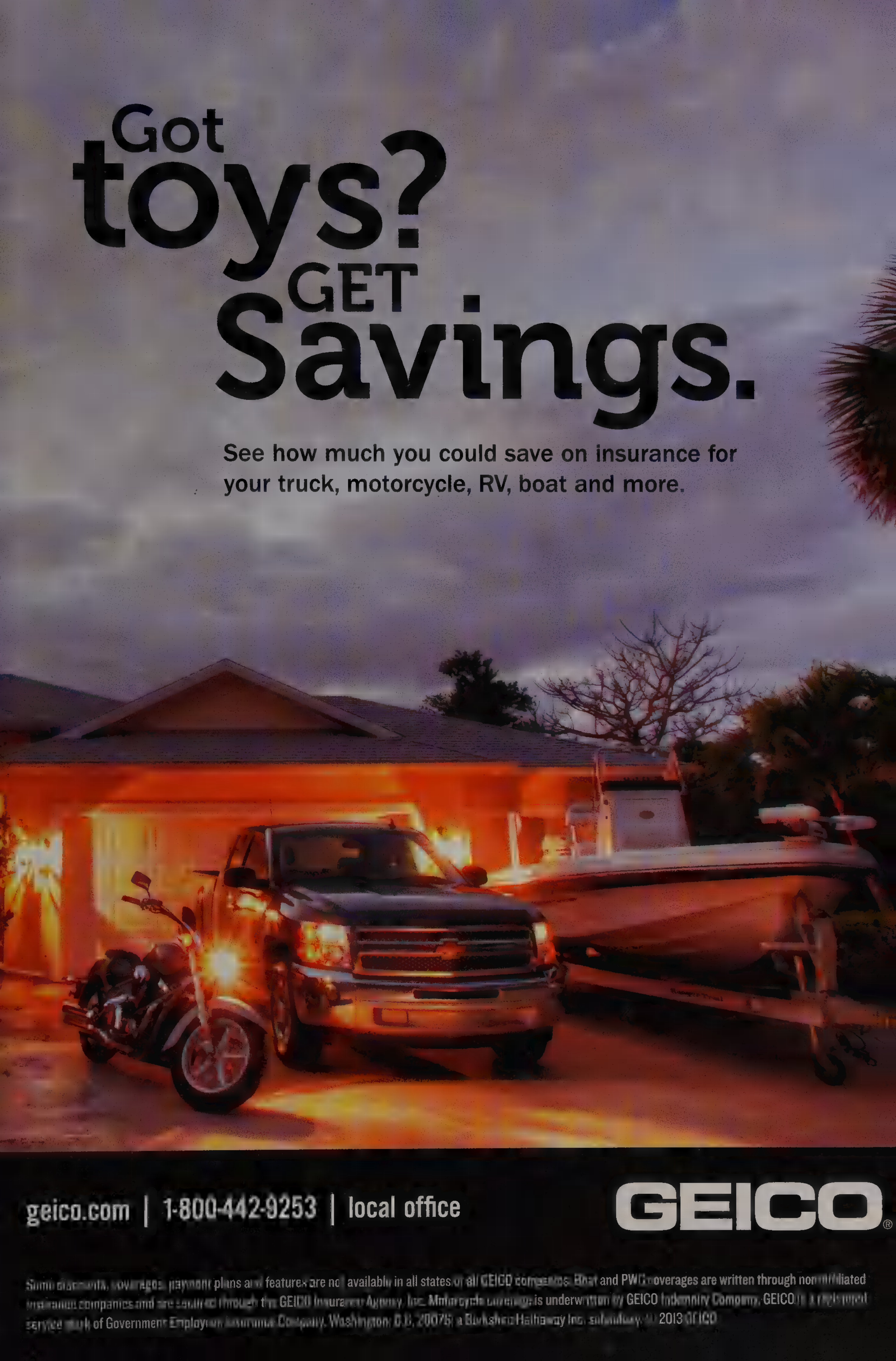
This kind of getting lost doesn't happen anymore; I would have a GPS with me now. But two decades ago at Camp Leakey, an orangutan research camp on Borneo inside Tanjung Puting, the rain forest was an unknowable place. I was trying to find the maroon leaf monkey. One day, after four hours of following marked trails, I thought I saw one. I risked it and went off the trail. Forty-five minutes later, I was still wandering, no maroon leaf monkey in sight. I assumed the trail had to pick up somewhere near where I was, so I used my compass to make a guess. Another 30 minutes later, I wasn't panicked, but I was definitely a little nervous. I had a headlamp, so I was somewhat prepared, but darkness was coming on quickly and finding my way back was only going to get more difficult.

There was much to admire off-trail—passing humans hadn't disturbed these parts of the rain forest yet. At one point I saw a shimmering metallic blue pool in an opening. I moved closer, and it vibrated, and hundreds of butterflies took wing. What I saw in their place was the sea of pig feces that had so interested them moments before.

I picked south on the compass. I figured I'd eventually hit the river, if not a trail first. It paid off. After about 20 minutes I saw an unmarked trail. Seconds later, I heard a rustling. I was thinking it was feral pigs or a small wildcat. I shone my headlamp where I thought the sound was coming from. It was an orangutan. The face was familiar: one of the tribe being rehabilitated at camp. The orangutan and I looked at each other, and she held out her hand to me. Then she led me, hand clasped in hand, to camp. Just like me, she was heading back for the evening.



ART: ISTVAN BANYAI. PHOTO: MATT CASHORE, UNIVERSITY OF NOTRE DAME



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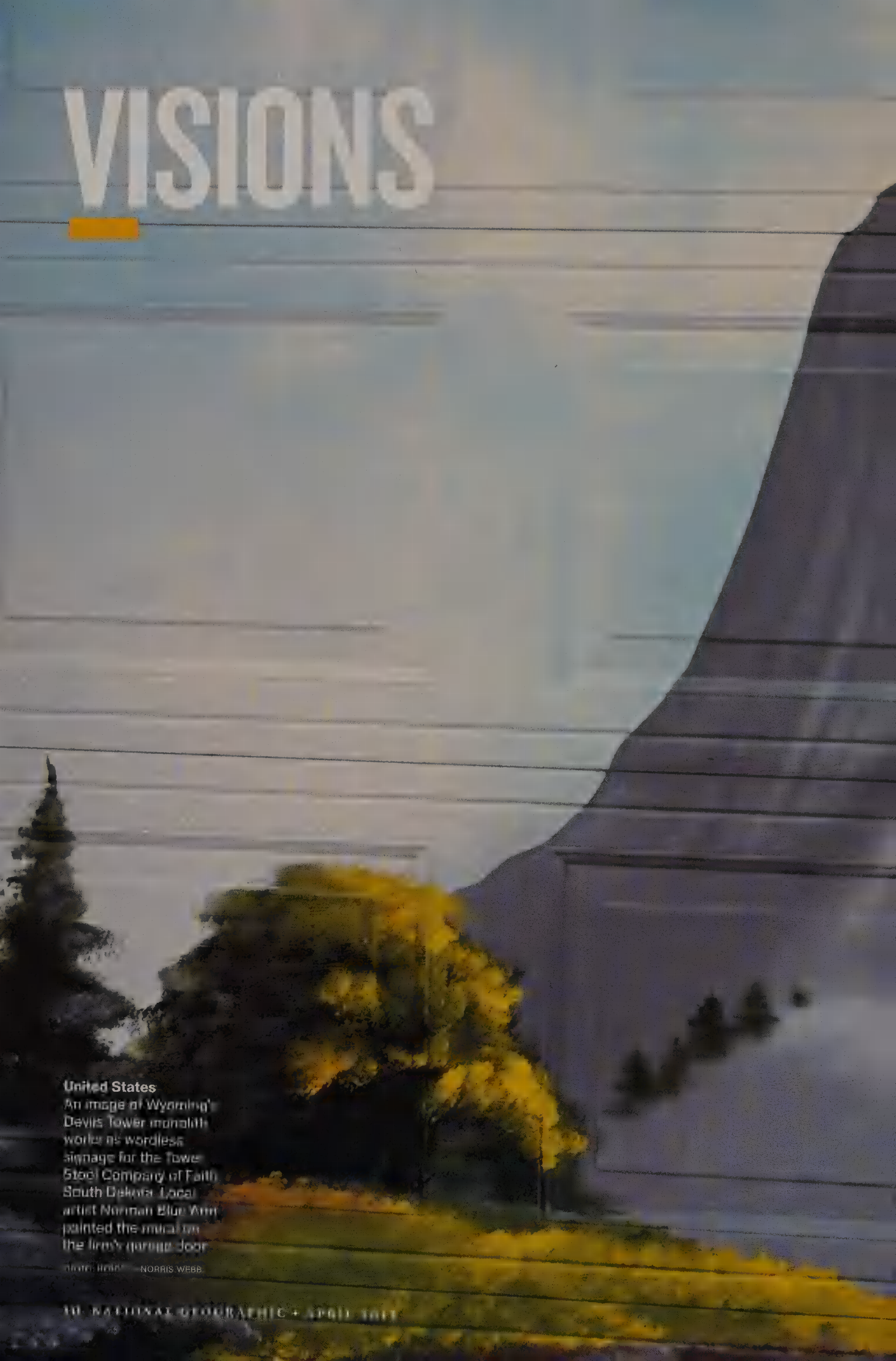
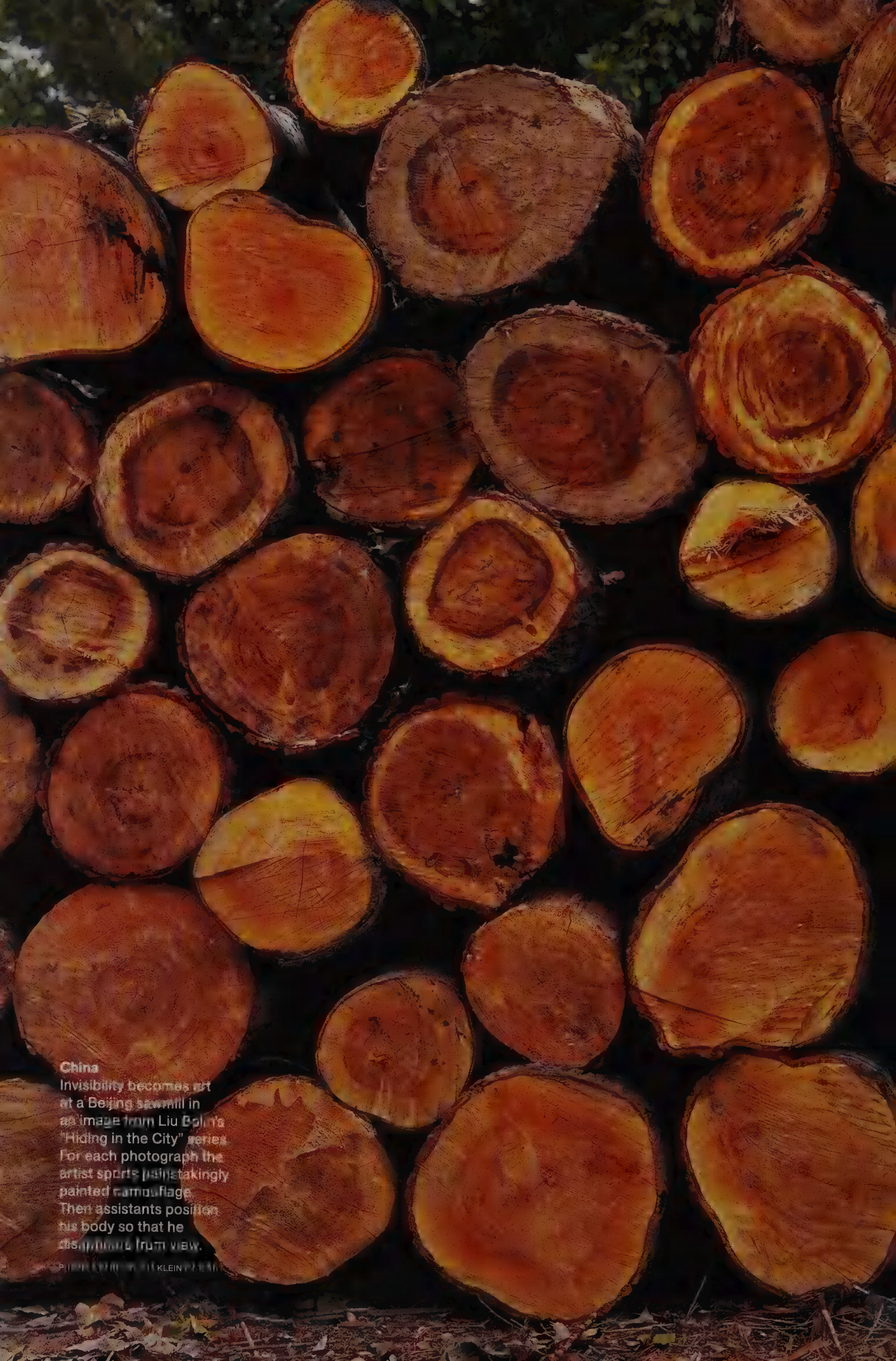
VISIONS



United States
An image of Wyoming's Devils Tower monolith works as wordless signage for the Tower Steel Company of Faith, South Dakota. Local artist Norman Blue Arm painted the mural on the firm's garage door.

PHOTO: REBECCA NORRIS WEBB



China

Invisibility becomes art at a Beijing sawmill in an image from Liu Bolin's "Hiding in the City" series. For each photograph the artist sports painstakingly painted camouflage. Then assistants position his body so that he disappears from view.

PHOTOGRAPH BY LIU BOLIN, ELI KLEIN FINE ART

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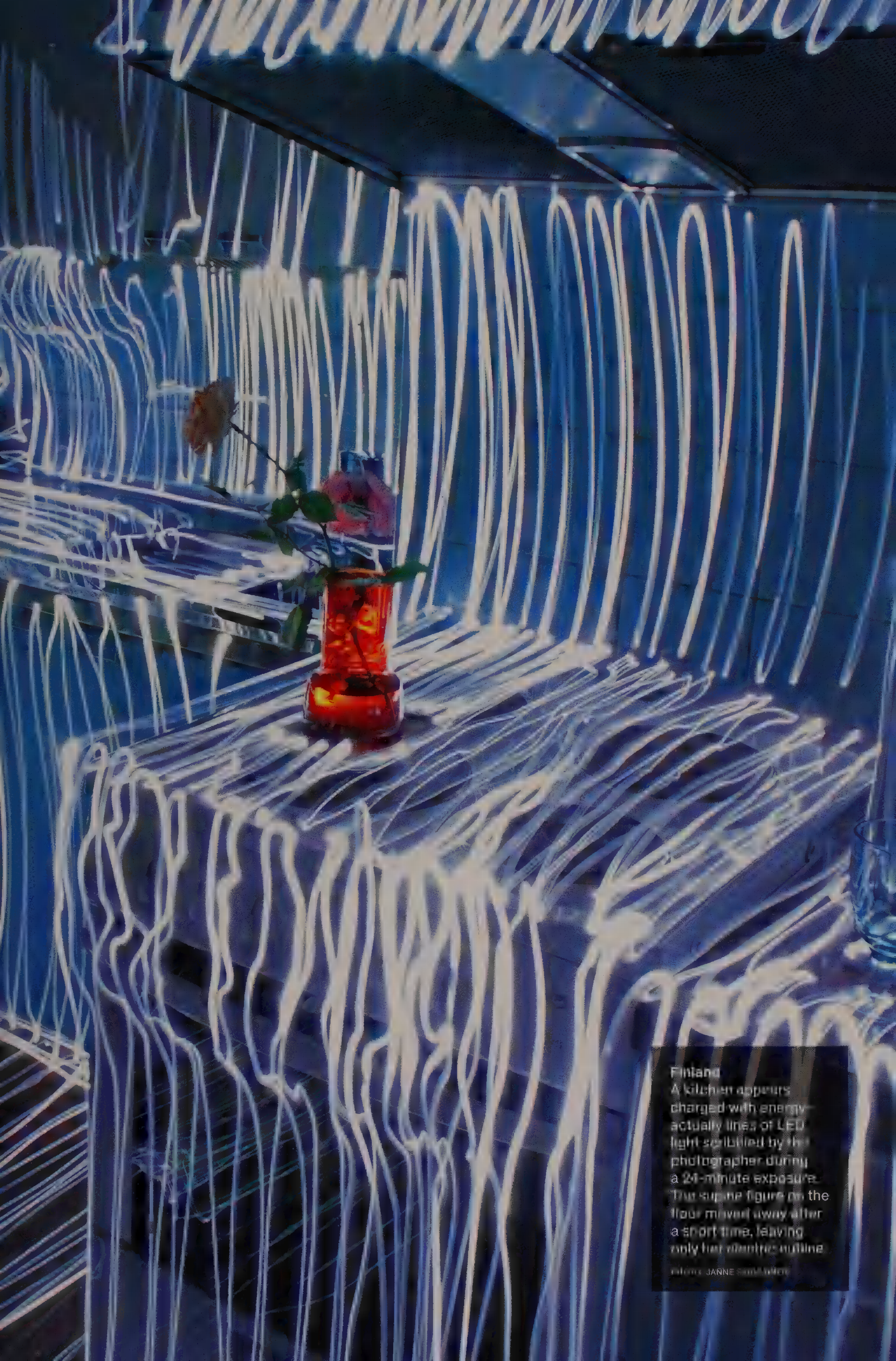
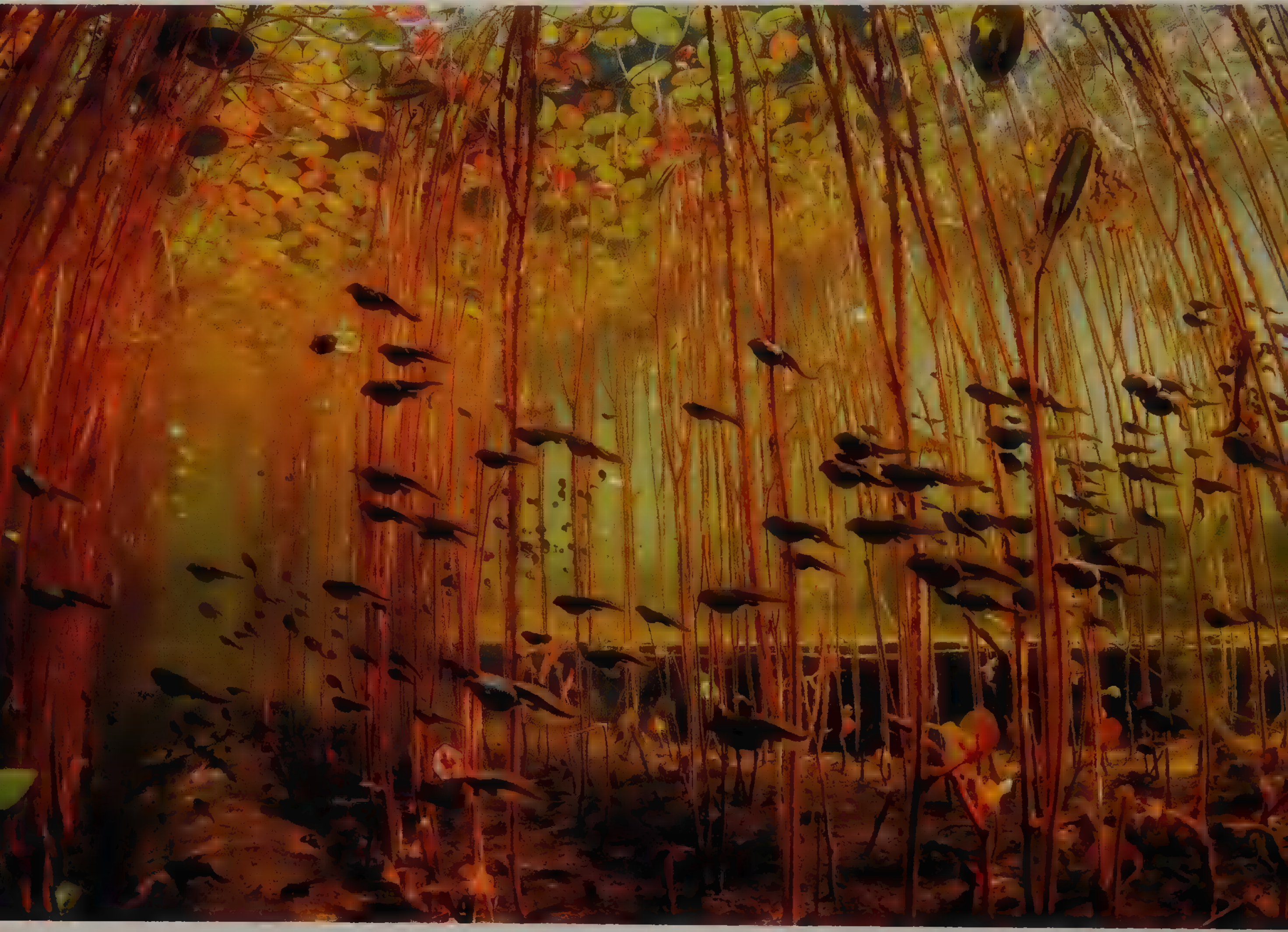


Finland
A kitchen appears charged with energy—actually lines of LED light scribbled by the photographer during a 24-minute exposure. The supine figure on the floor moved away after a short time, leaving only her electric outline.

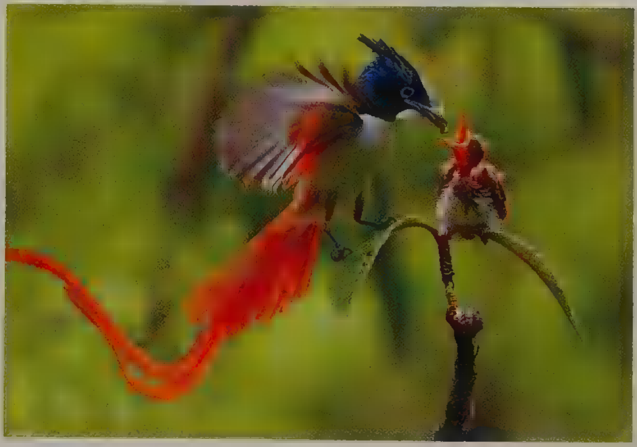
PHOTO: JANNE PARVIAINEN

This page features two photographs: one chosen by our editors and one chosen by our readers via online voting. For more information, go to *ngm.com/yourshot*.



EDITORS' CHOICE **Eiko Jones** Campbell River, British Columbia

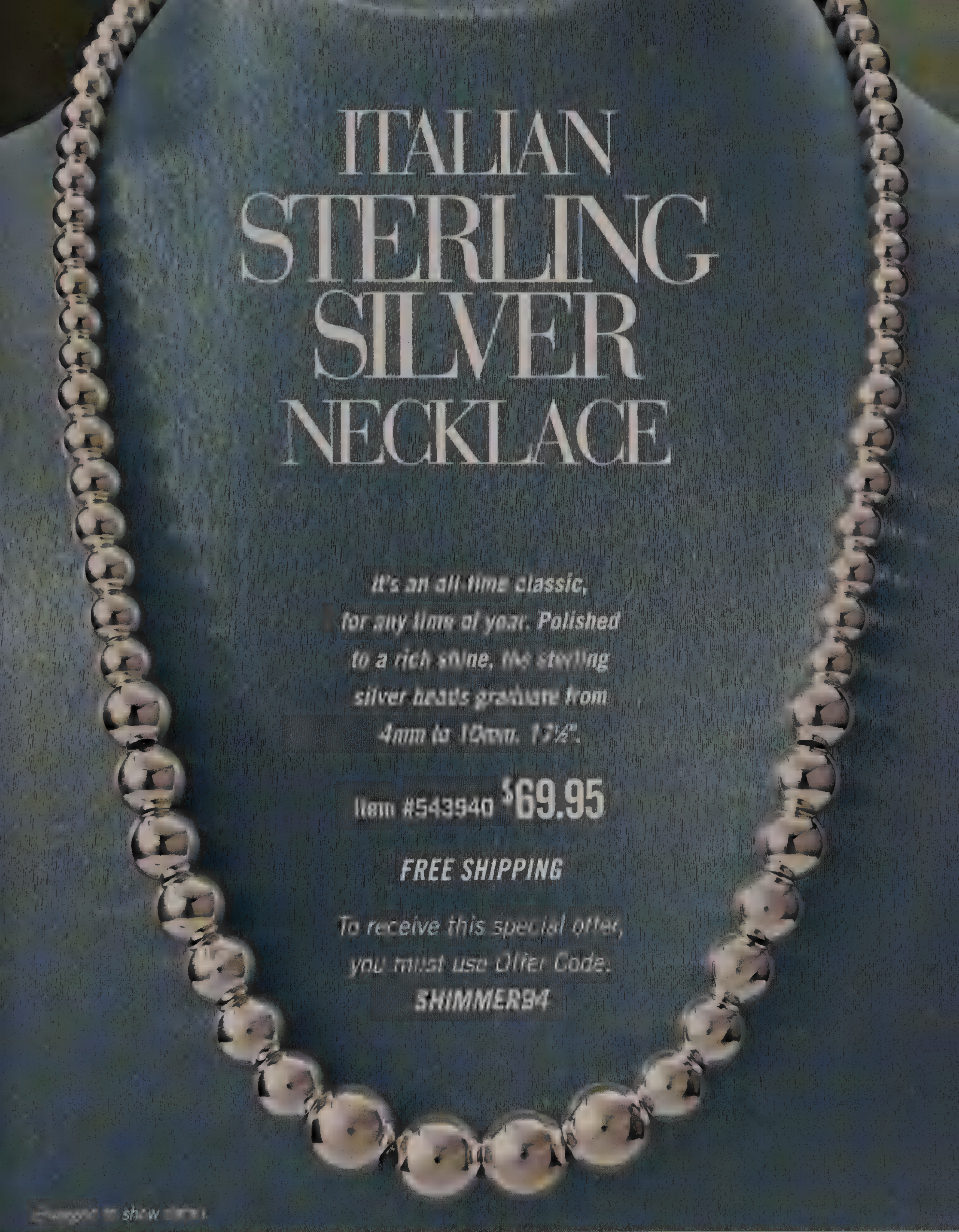
Jones was photographing water lilies from four feet under when he saw a "black cloud" in the corner of his eye. Countless tadpoles streamed by. "It went on for ages," says the 41-year-old photographer. "It was like a huge flock of birds flying through a forest, but completely silent."



READERS' CHOICE

Zahoor Ahmed
Bhalwal, Pakistan

"I'm deeply in love with birds," says Ahmed, a wildlife photographer. He spent two months near a saltwater lake in Kallar Kahar to capture this shot of an Asian paradise flycatcher feeding its chick. Despite his fancy feathers, the male does the feeding and incubates eggs in the nest.



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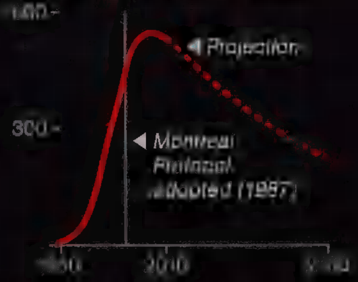
Ozone, Interrupted

"The Montreal Protocol is working," says chemist Mario Molina, who shared the Nobel Prize for his work on the effects of chlorofluorocarbons (CFCs). "CFCs are a global environmental problem that is being solved by society." The international treaty, which opened for signature in 1987, created controls on the use of CFCs, gases used as coolants in refrigerators and to propel aerosols like hair spray out of cans. The problem was that CFCs spread out in the stratosphere, where they led to a hole in the ozone layer.

When Molina started studying CFCs in the 1970s and discovered their role in ozone depletion, each U.S. household averaged 30 to 40 spray cans. Since the late '80s, CFC production has all but stopped, making modern spray cans ozone safe. The ozone layer itself? Though scientists say it will take until beyond 2050 to return to pre-1980s levels of CFCs—they take about a hundred years to decompose—the amounts in the atmosphere are steadily decreasing. —*Johnna Rizzo*

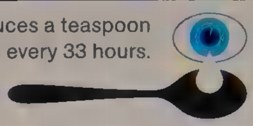
Atmospheric abundance of CFC-12*, *parts per trillion*



*CFC-12, commonly called Freon-12, was a popular refrigerant and aerosol propellant.

PHOTO: MARK THIESSEN, NGM STAFF. NGM ART. SOURCE: DAVID W. FAHEY, NOAA EARTH SYSTEM RESEARCH LABORATORY

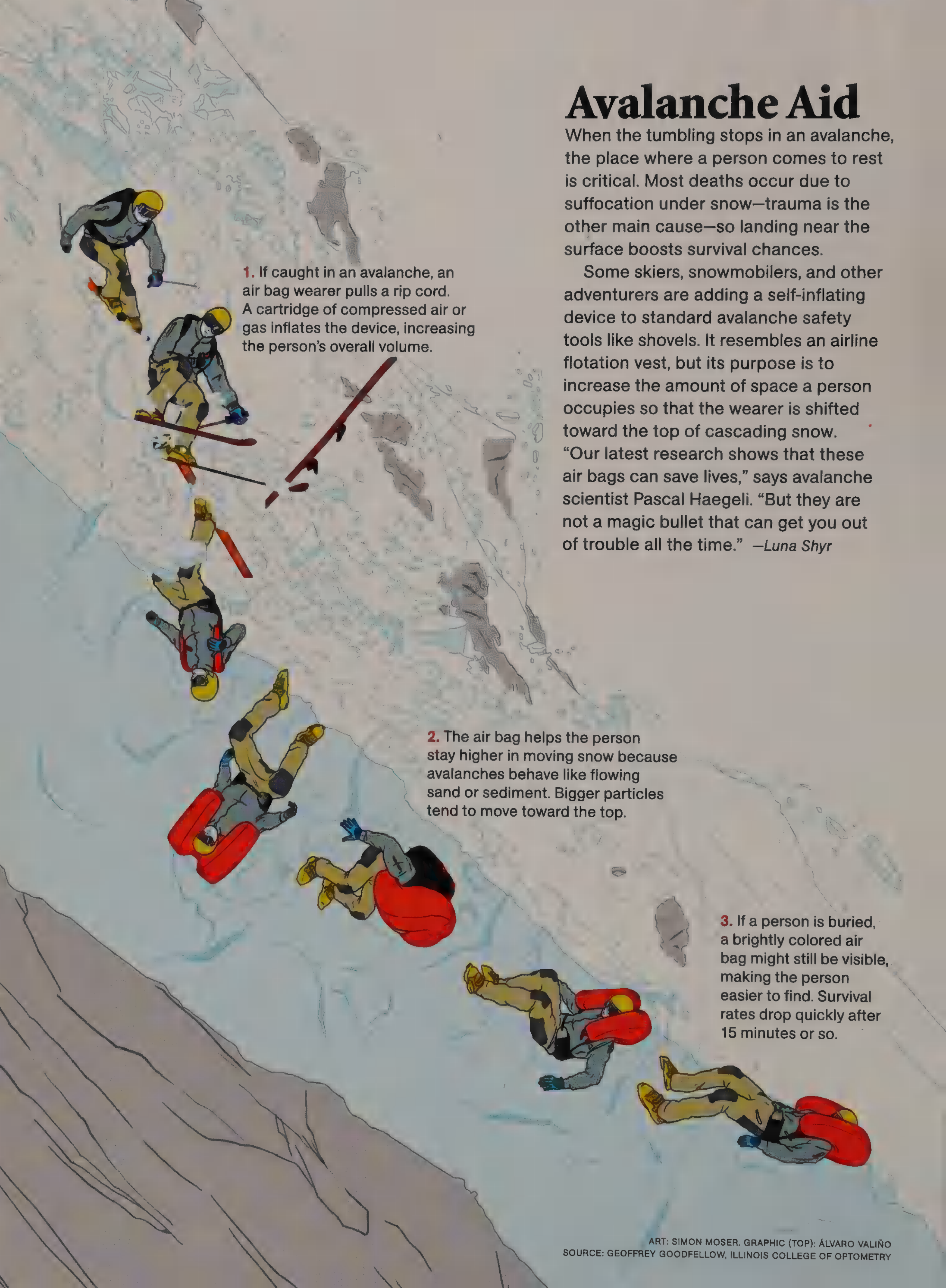
A human eye produces a teaspoon of tears every 33 hours.



Avalanche Aid

When the tumbling stops in an avalanche, the place where a person comes to rest is critical. Most deaths occur due to suffocation under snow—trauma is the other main cause—so landing near the surface boosts survival chances.

Some skiers, snowmobilers, and other adventurers are adding a self-inflating device to standard avalanche safety tools like shovels. It resembles an airline flotation vest, but its purpose is to increase the amount of space a person occupies so that the wearer is shifted toward the top of cascading snow. “Our latest research shows that these air bags can save lives,” says avalanche scientist Pascal Haegeli. “But they are not a magic bullet that can get you out of trouble all the time.” *—Luna Shyr*



1. If caught in an avalanche, an air bag wearer pulls a rip cord. A cartridge of compressed air or gas inflates the device, increasing the person’s overall volume.

2. The air bag helps the person stay higher in moving snow because avalanches behave like flowing sand or sediment. Bigger particles tend to move toward the top.

3. If a person is buried, a brightly colored air bag might still be visible, making the person easier to find. Survival rates drop quickly after 15 minutes or so.

ART: SIMON MOSER. GRAPHIC (TOP): ÁLVARO VALIÑO
SOURCE: GEOFFREY GOODFELLOW, ILLINOIS COLLEGE OF OPTOMETRY

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IN GOD WE TRUST
2013
UNITED STATES OF AMERICA
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1 OZ. FINE SILVER~ONE DOLLAR

Actual size is 40.6 mm

Millions Demand America's Purest Silver Dollar. Shouldn't You?

Secure Your New 2013 Silver Eagles Now!

Millions of people collect the American Eagle Silver Dollar. In fact it's been the country's most popular Silver Dollar for over two decades. Try as they might, that makes it a very hard "secret" to keep quiet. And right now, many of those same people are lining up to secure the new 2013 U.S. Eagle Silver Dollars — placing their orders now to ensure that they get America's newest Silver Dollar — in stunning Brilliant Uncirculated condition — before millions of others beat them to it.

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Why are we releasing the most popular silver dollar in America for a remarkably affordable price? We're doing it to introduce you to what hundreds of thousands of smart collectors and satisfied customers have known since 1984 — New York Mint is the place to find the world's finest coins.

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You must be 100% satisfied with your 2013 Brilliant Uncirculated American Eagle Silver Dollars or return them within 30 days of receipt for a prompt refund *(less s/h)*. Don't miss out on this limited release. Call immediately to secure these American Eagle Silver Dollars ahead of the crowd.

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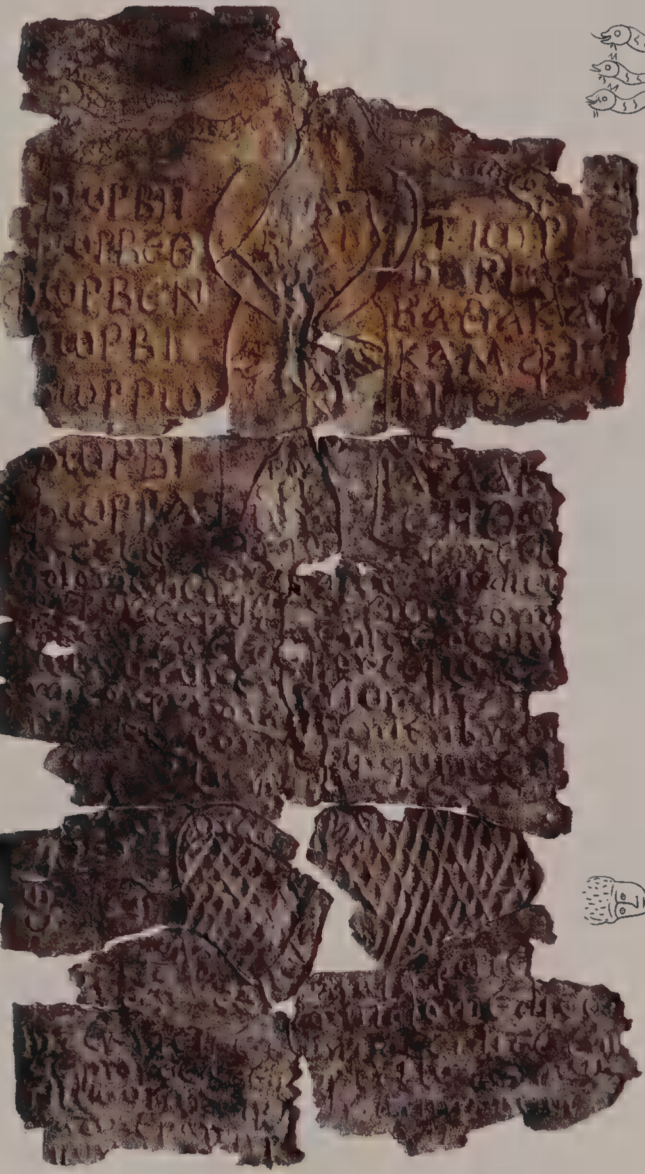
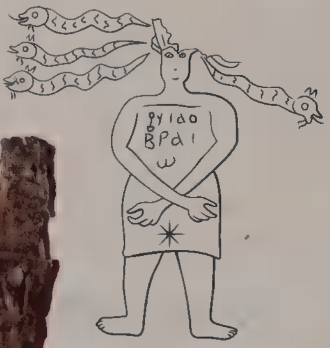
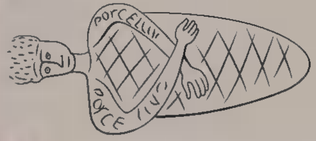




A curse tablet (left) invokes a deity—perhaps the goddess Hecate, queen of witches—with a crown of snakes.

"May all Porcello's body, limbs, entrails ... disintegrate, languish, and collapse ... soul, heart, buttocks."

(PARTIAL TRANSLATION)



A bound figure depicts the curse's target, in this case a veterinarian named Porcello.

Curses, Foiled

Citizens of the Roman Empire had a habit of writing when they were wronged. They etched grievances into thin sheets of lead, which were rolled and pierced with nails, then buried in tombs or thrown into wells. A newly translated 1,600-year-old tablet (above) seeks to impart vengeance on a veterinarian named Porcello.

There was no gripe too small. Researchers have found more than 1,500 curse tablets, including 130 around Aquae Sulis (now Bath, England) seeking revenge for shoes and other items stolen while their owners were in the water. Some are signed; some depict the perpetrator. Many petition a deity with powers to befoul the suspect's life. Why do such complaints matter? "They're documents of the common people's concerns," says Celia Sánchez Natalías of Spain's University of Zaragoza, "not Augustus's or Cicero's." *—Johnna Rizzo*

An Eye for an Eye

In some cultures over-complimenting casts a curse. So does envy. Since ancient times such maledictions have been collectively called the evil eye. According to folklorist Alan Dundes's book *The Evil Eye*, the belief's premise is that an individual can cause harm simply by looking at another's person or property.

But protection is easy to come by—with talismans that can be worn, carried, or hung in homes, most often incorporating the contours of a human eye (like the Egyptian one, below). In Aegean countries people with light-colored eyes are thought to be particularly powerful, and amulets in Greece and Turkey are usually blue orbs. Indians, Muslims, and Jews use charms with palm-forward hands with an eye in the center; Italians employ horns, phallic shapes meant to distract spell casters. *—JR*

ART: JOSHUA MAXWELL. PHOTOS: CELIA SÁNCHEZ NATALÍAS, UNIVERSITY OF ZARAGOZA, SPAIN (TABLET); METROPOLITAN MUSEUM OF ART/ART RESOURCE, NY

Legal Notice

If You Purchased and/or Paid for Flonase or Generic Flonase

A Class Action Settlement Could Affect You

A proposed Settlement has been reached in a class action lawsuit regarding the prescription nasal spray Flonase. The lawsuit claims that the seller of Flonase violated state laws by delaying the availability of generic versions of Flonase. The seller is SmithKline Beecham Corporation doing business as GlaxoSmithKline (“GSK”). GSK denies it has done anything wrong but agreed to the Settlement to resolve the controversy and to avoid the cost and expense of further litigation.

No one is claiming that Flonase or its generic equivalent is unsafe or ineffective.

Who is included?

You are a Consumer Class Member if you:

- Purchased and/or paid for Flonase and/or its generic equivalents,
- Anywhere in the United States and its territories,
- For personal, family or household use,
- Between May 19, 2004, and March 31, 2009.

You “purchased and/or paid for” Flonase or generic Flonase (fluticasone propionate nasal spray) if you were:

(a) An uninsured consumer who paid the entire cost of the prescription, or

(b) An insured consumer who made a co-payment or other partial out-of-pocket payment, or paid the entire cost because you had not met a deductible amount under your health plan.

What does the Settlement Provide?

GSK will pay $35 million into a Settlement Fund to settle all claims in the lawsuit brought on behalf of consumers and health insurers known as Third-Party Payors or “TPPs. A group of TPPs called Settling Health Plans (“SHPs”) also settled with GSK under a separate agreement for $11 million. To make sure their payments were approximately proportionate to those of Class Members, SHPs may receive payments from or contribute payments to the Class Settlement Fund.

Class Counsel will ask the Court to award attorneys’ fees in an amount not to exceed one-third of the Settlement Fund, plus interest, litigation expenses and incentive payments to the Class Representatives. After these deductions and any SHP payments, the remainder of the Class Settlement Fund will be distributed *pro rata* to Class Members.

What can I get from the Settlement?

The amount of money you are eligible to receive will depend on how much you paid for Flonase and generic Flonase and on how much other Class Members and SHPs paid and/or reimbursed.

How do I get a payment?

Submit a Claim Form by **August 15, 2013**. See below.

What are my other rights?

If you do not want to be legally bound by the Settlement, you must exclude yourself from the Settlement. The exclusion deadline is **May 3, 2013**. If you stay in the Settlement you will not be able to sue GSK for any claims relating to the Settlement. You will be bound by all the Court’s orders. However, if you stay in the Settlement, you may object to it by **May 3, 2013**.

The Court will hold a hearing on **June 3, 2013 at 10:30 a.m.** to consider whether to approve the Settlement and a request for attorneys’ fees, expenses and incentive awards. The Court has appointed attorneys to represent the Class. You or your own lawyer may ask to appear and speak at the hearing at your own expense.

Call Toll-Free: 1-800-549-1836 Visit: www.FlonaseSettlement.com

Gut Reactions

Since the 1950s U.S. rates of celiac disease—an autoimmune condition in which the body treats gluten as a toxin—have at least quadrupled. It now affects one in 141. Gluten overload in Western diets is a culprit, says the Mayo Clinic's Joseph Murray. No one can fully digest gluten, a protein found in wheat, rye, and barley. Early humans didn't eat grains, so people didn't evolve the ability to break it down. Most people can get rid of what's left of gluten as waste and be fine, but for those with celiac disease, eating's out.

Modern wheat choices likely exacerbate the problem, Murray adds. Today's farmers prefer protein-rich varieties that produce greater yields; breadmakers prize higher gluten content because it improves texture. Even more gets added to processed foods like pretzels and pizza crusts, for density, and hamburger buns, to keep hinges tight. Gluten is also showing up outside the bread aisle, keeping ground spices from clumping and boosting protein in lunch meats. *—Johna Rizzo*

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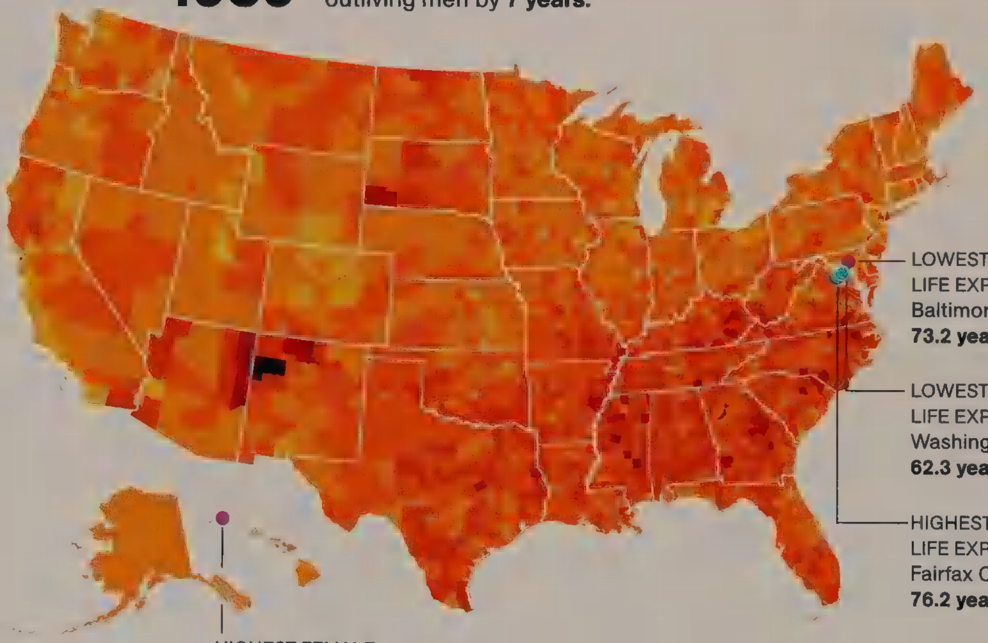
[1] *Car and Driver*, January 2013. [2] For more information, visit Edmunds.com. Edmunds and the Edmunds.com logo are registered trademarks of Edmunds.com, Inc. [3] Vehicle's projected resale value is specific to the 2013 model year. For more information, visit Kelley Blue Book's KBB.com. Kelley Blue Book is a registered trademark of Kelley Blue Book Co., Inc. [4] For more information, visit KBB.com. Kelley Blue Book is a registered trademark of Kelley Blue Book Co., Inc. [5] Based on frontal crash, side crash and rollover categories. Government 5-Star Safety Ratings are part of NHTSA's New Car Assessment Program (www.SaferCar.gov). Model tested with standard side airbags (SABs). Vehicles tested under the new program cannot be compared to MY10 and earlier vehicles. [6] ALG is the industry benchmark for residual values and depreciation data, www.alg.com. [7] Durability based on longevity. Longevity based on Polk U.S. vehicles in operation registration statistics 1998–2010 for Accord and competing models.

Ladies Last

How long do you have? It depends on gender and geography. In the U.S., women live longer—81 years on average, 76 for men—but a recent study by the Institute for Health Metrics and Evaluation reveals a troubling trend. Though men's life spans have increased by 4.6 years since 1989, women have gained only 2.7 years, perhaps because a larger percentage of women have lacked adequate treatment for high blood pressure and cholesterol. "This is a wake-up call," says study co-author Ali Mokdad.

Geographic gaps have also widened; parts of the South are a full decade behind places like coastal California. Public health initiatives like smoking bans and more sidewalks have made a big difference, says Mokdad. "People are living to 86, on average, in some parts of the world. Why shouldn't Americans do the same?" *—Amanda Fiegl*

1989 Nationwide, women were outliving men by **7 years.**



LOWEST FEMALE
LIFE EXPECTANCY
Baltimore, MD
73.2 years

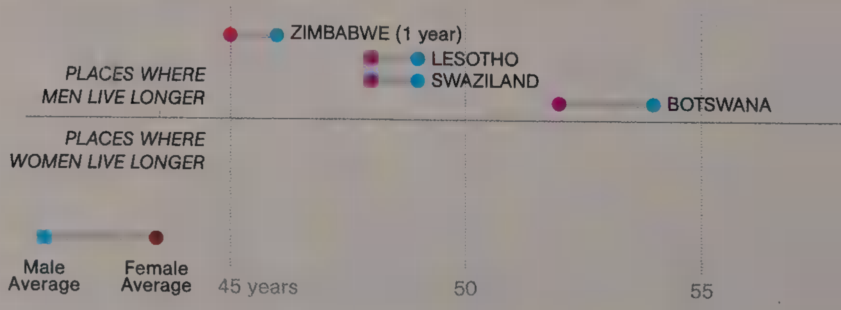
LOWEST MALE
LIFE EXPECTANCY
Washington, DC
62.3 years

HIGHEST MALE
LIFE EXPECTANCY
Fairfax County, VA
76.2 years

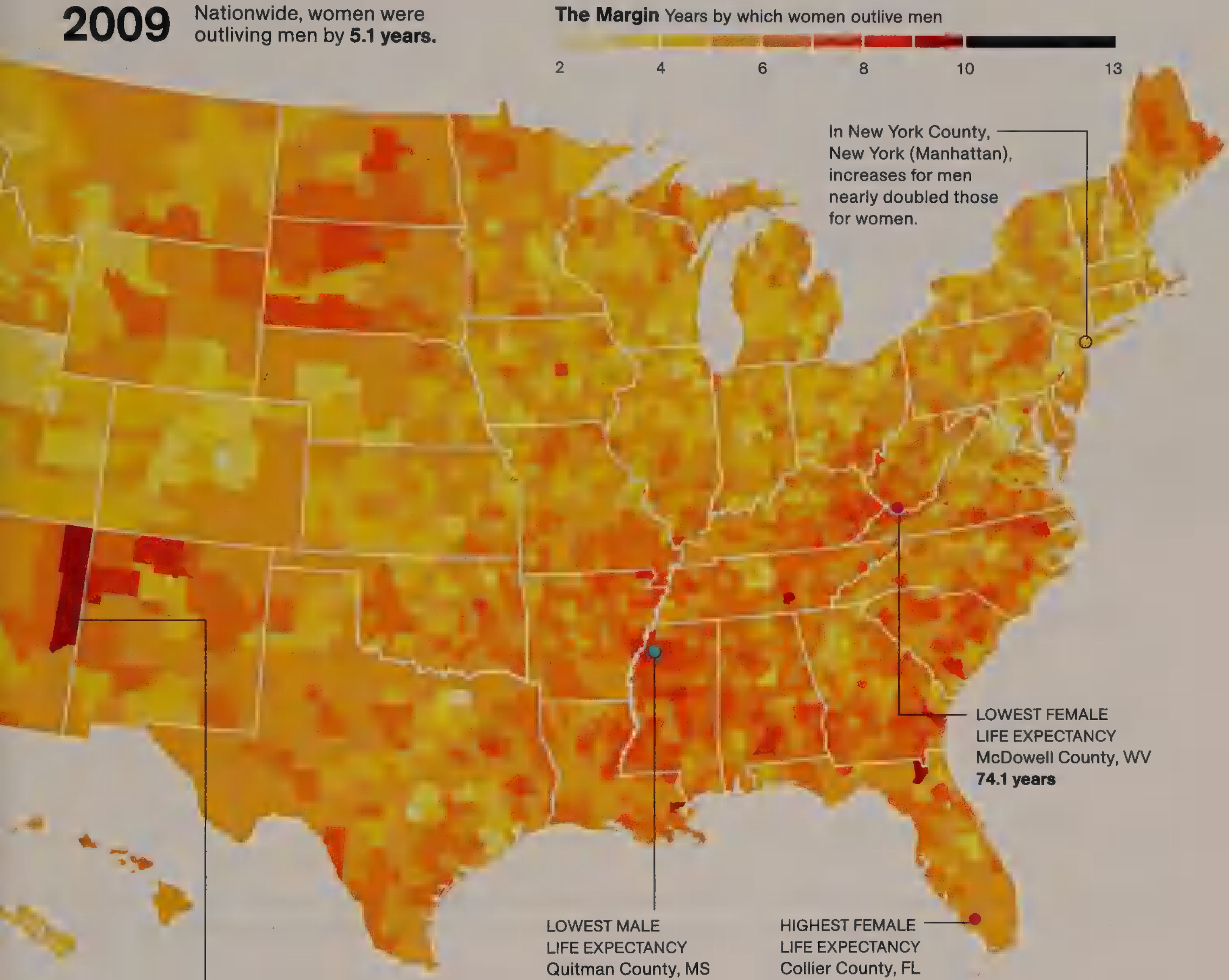
HIGHEST FEMALE
LIFE EXPECTANCY
Kauai, HI
81.9 years

HIGHEST MALE
LIFE EXPECTANCY
Marin County, CA
81.6 years

A GLOBAL GAP
People in the developed world typically live several decades longer than those in sub-Saharan Africa, where HIV/AIDS has taken a severe toll. Worldwide, women outlive men by an average of five years, with a few notable exceptions.



2009 Nationwide, women were outliving men by **5.1 years.**



In New York County, New York (Manhattan), increases for men nearly doubled those for women.

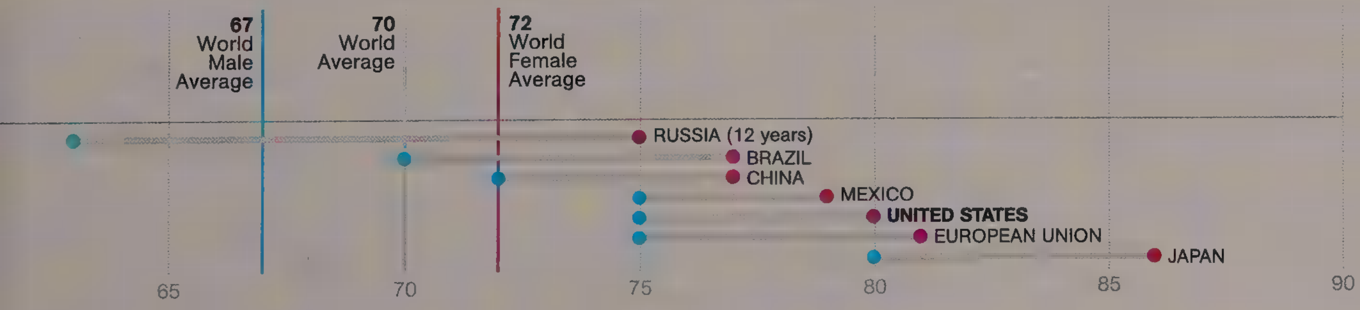
LOWEST FEMALE LIFE EXPECTANCY
McDowell County, WV
74.1 years

LOWEST MALE LIFE EXPECTANCY
Quitman County, MS
66.1 years

HIGHEST FEMALE LIFE EXPECTANCY
Collier County, FL
85.8 years

In Apache County, Arizona, women outlived men by nearly a decade—one of the highest margins of difference in the U.S.

See life expectancy averages across the U.S., county by county, on our digital editions.



GRAPHICS: LAZARO GAMIO

SOURCES: INSTITUTE FOR HEALTH METRICS AND EVALUATION; U.S. CENSUS BUREAU; POPULATION REFERENCE BUREAU

Legal Notice

If You Own or Owned Land Under or Next to Railroad Rights of Way Where Fiber-Optic Cable Was Installed

You Could Receive Money from a Class Action Settlement

State-by-state Settlements have been reached in class action lawsuits challenging the installation of fiber-optic cable within railroad Rights of Way. Under the Settlements, Sprint, Qwest, WilTel, or Level 3 Communications (together called the "Defendants") will pay valid claims for persons in 12 states who own or owned land next to or under railroad Rights of Way where fiber-optic cable owned by Sprint, Qwest, WilTel, or Level 3 Communications is buried.

Who Is Included?

Class Members include current or previous owners of land next to or under a railroad Right of Way at any time since the cable was installed in the 12 states listed below.

To find where the Rights of Way included in the Settlements are located and when fiber-optic cable was installed in a particular Right of Way, visit www.FiberOpticSettlements.com. If you still have questions, call 1-800-378-1670.

What Are the Proposed Settlement Terms?

Class Members who submit a valid claim will receive cash based on factors that include: (a) the length of the Right of Way where the cable is installed, (b) the length of time they owned the property, and (c) whether the Right of Way was created by a federal land grant. The Settlements provide Defendants with a permanent Telecommunications Easement. The Easement will grant any rights the Defendants don't already have to use the Rights of Way for Telecommunications Facilities.

What Are Class Member Rights?

- If you stay in the Class, you will have an opportunity to claim cash benefits. You will be bound by the decisions of the Court. You can't sue Defendants or the railroads in the future for any claims in this lawsuit, and a Telecommunications Easement will be granted on the railroad Right of Way next to or through your property. If you think you are a member of the Class, but did not receive a mailed notice, call 1-800-378-1670.
- You can exclude yourself from the Class. This means you cannot file a claim for cash benefits but will keep the right to sue the Defendants in the future.
- If you stay in the Class, you can object to all or part of the Settlement in a state where you own or owned property.
- Exclusions and objections must be filed in writing by **April 15, 2013**.

Who Represents Class Members?

Class Counsel have been appointed by the Court to represent you. They will request an award of attorneys' fees, which will vary by state, to be paid by Defendants. If you wish, you or your own attorney may ask to appear and speak at the hearing at your own cost. See the website for more information on attorneys' fees.

Will an Approval Hearing Be Held?

Approval hearings will be held in each state for which there is a Settlement. Refer to the chart below for the dates of each hearing. Please visit the website or call the toll-free number to find out the time and location of the hearing in the state where your property is.

Dates of Final Approval Hearings

California	6/17/13	New Hampshire	9/10/13	Rhode Island	6/21/13
Connecticut	6/24/13	Ohio	6/13/13	South Carolina	8/6/13
Kentucky	6/18/13	Oregon	6/13/13	South Dakota	6/10/13
Nevada	6/11/13	Pennsylvania	11/4/13	Washington	6/14/13

For More Information: Visit www.FiberOpticSettlements.com or call 1-800-378-1670

PHOTO: NEL CEPEDA

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Pat Minnick decided to establish a charitable gift annuity to support National Geographic. She now receives a guaranteed life income and is a direct part of the Society's efforts to inspire people to care about the planet. She says, "I feel good knowing that National Geographic is doing so much to protect endangered wildlife."

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☐ I have already included National Geographic in my will.

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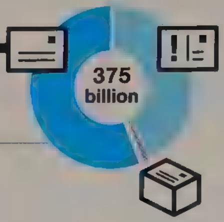
Globally, nearly 375 billion pieces of mail were sent in 2011: 98.3% were letters (42% was advertising); 1.7% were packages.



Aerial Assaults

In terms of weight, a raindrop on a mosquito is like a car on a human—and the little suckers get hit every 25 seconds in heavy rain. How do they survive? By not resisting, say Georgia Institute of Technology engineers.

"Imagine punching a balloon in midair. You won't destroy it," says lead researcher David Hu. "Similarly, mosquitoes are so light that they offer very little resistance. They just go along for the ride." A drop shoves the bug downward at 100 to 300 times the force of gravity—enough to crush a human, but mosquitoes have superstrong exoskeletons. They usually slide free in less than a second.

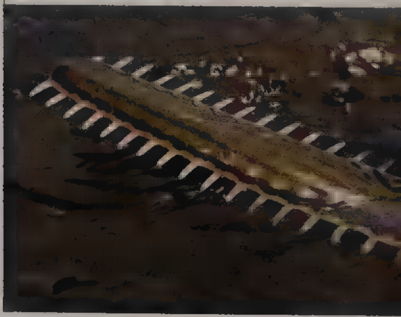
Mimicking the mosquitoes could inspire designs for tougher aerial robots, to aid in search and rescue, says Hu. "If a robot could be as lightweight as a mosquito, it would be very resilient." *—Amanda Fiegl*

Samurai of the Sea

Sawfish do actually saw fish. Surprising new observations show that these stingray relatives use their long, tooth-lined saws (below) to dismember prey. Previously scientists thought the seemingly docile fish used their saws—actually extensions of their skulls—to probe muddy bottoms. By watching captured specimens, sensory neurobiologist Barbara Wueringer discovered the opposite: The roughly 16-foot fish are active hunters that can swipe their saws up to four times a second.

The "samurai of the sea," as she calls them, can also split a fish in half, impale it, or sweep it onto the seafloor for easier eating. Wueringer found that the saws, which can grow up to several feet long, have pores that sense an animal's electric field, giving the wielder a sort of fishy sixth sense.

—Christine Dell'Amore



PHOTOS: TIM NOWACK, DAVID HU, AND ANDREW DICKERSON, GEORGIA INSTITUTE OF TECHNOLOGY; THOMAS P. PESCHAK (SAWFISH). GRAPHIC: LAWSON PARKER, NGM STAFF. SOURCE: UNIVERSAL POSTAL UNION

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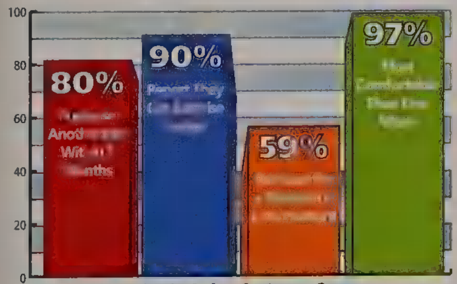

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Sizes 5 - 11

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If You Currently or Previously Owned, Purchased, or Leased Certain Toyota, Lexus, or Scion Vehicles,

You Could Get Benefits from a Class Action Settlement.

There is a proposed settlement in a class action lawsuit against Toyota Motor Corp. and Toyota Motor Sales, U.S.A., Inc. ("Toyota") concerning certain vehicles with electronic throttle control systems ("ETCS"). Those included in the settlement have legal rights and options and deadlines by which they must exercise them.

What is the lawsuit about?

The lawsuit alleges that certain Toyota, Lexus, and Scion vehicles equipped with ETCS are defective and can experience unintended acceleration. Toyota denies that it has violated any law, denies that it engaged in any and all wrongdoing, and denies that its ETCS is defective. The Court did not decide which side was right. Instead, the parties decided to settle.

Am I Included in the proposed settlement?

Subject to certain limited exclusions, you are included if as of **December 28, 2012**,

- You own or owned, purchase(d), and/or lease(d) a "Subject Vehicle" that was
- Distributed for sale or lease in any of the fifty States, the District of Columbia, Puerto Rico and all other United States territories and/or possessions or
- Were a company that insured Subject Vehicles for residual value.

The Subject Vehicles are identified at the settlement website and in the full settlement notice available on the website or through the toll-free number below. The class includes persons, entities and/or organizations.

This settlement does not involve claims of personal injury or property damage.

What does the settlement provide?

The proposed settlement provides for: (a) cash payments from two funds totaling $500 million for certain eligible class members; (b) free installation of a brake override system on certain Subject Vehicles; (c) a customer support program to correct any defect in materials or workmanship of certain vehicle parts for other eligible class members; and (d) at least $30 million toward automobile safety research and education. Some of these benefits require action by class members by or before certain deadlines.

Payments will vary depending upon several factors such as the number of claims submitted, the amounts claimed, and other adjustments and deductions.

What are my options?

If you do nothing, you will remain in the class and will not be able to sue Toyota about the issues in the lawsuit, but you may not receive certain cash benefits for which you may be eligible.

You can exclude yourself by **May 13, 2013**, if you don't want to be part of the settlement. You won't get any settlement benefits, but you keep the right to sue Toyota about the issues in the lawsuit.

You can submit a claim form by **July 29, 2013**, if you don't exclude yourself, for any cash benefits for which you are eligible and which require a claim form.

You can object to all or part of the settlement by **May 13, 2013**, if you don't exclude yourself.

The full settlement notice describes how to exclude yourself, submit a claim form and/or object.

The Court will hold a fairness hearing on **June 14, 2013 at 9:00 a.m.** to (a) consider whether the proposed settlement is fair, reasonable, and adequate and (b) decide the plaintiffs' lawyers' request for fees up to $200 million and expenses up to $27 million and other awards for Named Plaintiffs and Class Representatives. You may appear at the hearing, but you are not required to and you may hire an attorney to appear for you, at your own expense.

For more information or a claim form:

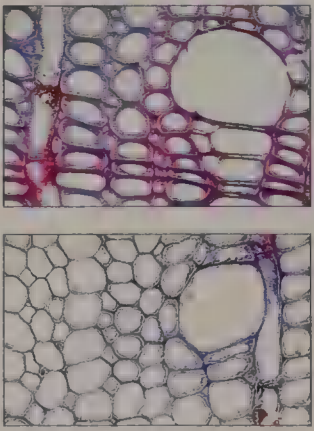
1-877-283-0507 www.toyotaelsettlement.com

Fingernails grow about twice as fast as toenails.

Strings Theory

Call it an encore. Fungi may be able to deliver the sounds of a Stradivarius. Violins work like this: Bowed strings vibrate the bridge beneath them; the bridge moving against the violin's body bounces sound. Stradivarius violins from the 1700s are said to move the notes around best. According to tree pathologist Francis Schwarze (above), applying two arboreal fungi—*Physisporinus vitreus* and *Xylaria longipes*—to a lesser violin can help it perform on a par with the famed maker's instruments.

The fungi work by thinning cell walls in Norway spruce—the only wood used to make a violin's top plates—and maple so that sound can move more freely. Less weight means louder and more resonant tones. It's not all about volume, though. The fungi also double the dampening function of the wood, taking away too-high, irritating sounds. Schwarze says fungi can improve other instruments as well, including hammer dulcimers and guitars. *—Johnna Rizzo*



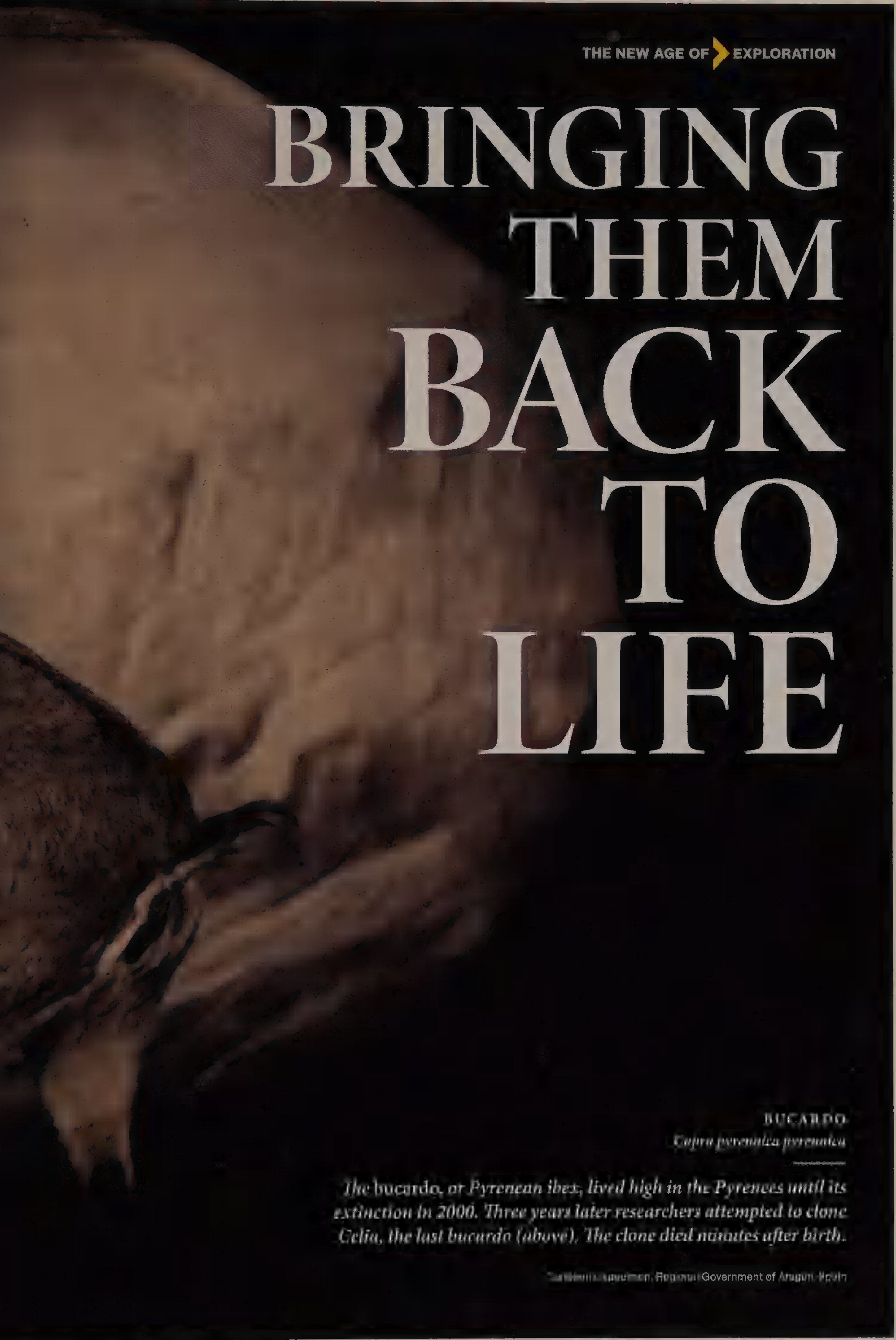
A fungus applied to a violin's maple plate thins cell walls (bottom), so sound travels better.

ETCETERA

President Barack Obama created **CÉSAR CHÁVEZ NATIONAL MONUMENT** in California, an area that includes the late activist's former home. • Australian researchers found that each mother **FAIRY WREN** teaches unhatched chicks a feeding "password" to help her identify her brood. • A species of **PHYTOPLANKTON** is the first known sun-fed organism that flees from predators, say scientists in Rhode Island. • A Netherlands study gauging reactions to armpit sweat suggests humans haven't lost the ability to **SMELL FEAR.**

PHOTOS: CHRISTIAN GRUND, 13 PHOTO (TOP); SWISS FEDERAL MATERIALS TESTING FACILITY (EMPA)
GRAPHIC: ÁLVARO VALIÑO. SOURCE: SIRIN YAEMSIRI, UNC GILLINGS SCHOOL OF GLOBAL PUBLIC HEALTH

The revival of an
extinct species is no
longer a fantasy.
But is it a good idea?



BRINGING THEM BACK TO LIFE

BUCARDO
Capra pyrenaica pyrenaica

The bucardo, or Pyrenean ibex, lived high in the Pyrenees until its extinction in 2000. Three years later researchers attempted to clone Celia, the last bucardo (above). The clone died minutes after birth.

Taxidermic specimen, Regional Government of Aragon, Spain

BY CARL ZIMMER

PHOTOGRAPHS BY ROBB KENDRICK

On July 30, 2003, a team of Spanish and French scientists reversed time. They brought an animal back from extinction, if only to watch it become extinct again.

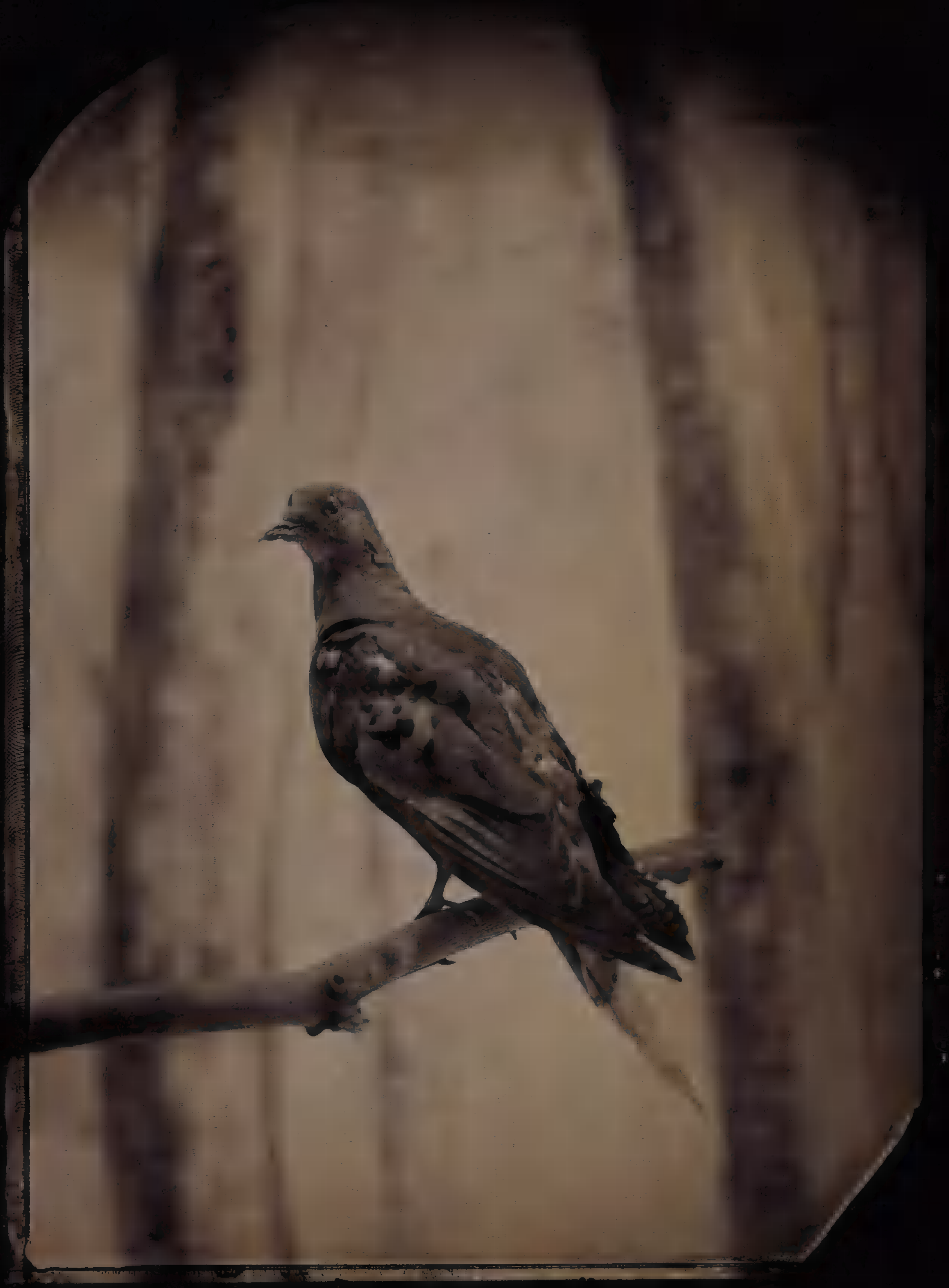
The animal they revived was a kind of wild goat known as a *bucardo,* or Pyrenean ibex. The bucardo *(Capra pyrenaica pyrenaica)* was a large, handsome creature, reaching up to 220 pounds and sporting long, gently curved horns. For thousands of years it lived high in the Pyrenees, the mountain range that divides France from Spain, where it clambered along cliffs, nibbling on leaves and stems and enduring harsh winters.

Then came the guns. Hunters drove down the bucardo population over several centuries. In 1989 Spanish scientists did a survey and concluded that there were only a dozen or so individuals left. Ten years later a single bucardo remained: a female nicknamed Celia. A team from the Ordesa and Monte Perdido National Park, led by wildlife veterinarian Alberto Fernández-Arias, caught the animal in a trap, clipped a radio collar around her neck, and released her back into the wild. Nine months later the radio collar let out a long, steady beep: the signal that Celia had died. They found her crushed beneath a fallen tree. With her death, the bucardo became officially extinct.

But Celia's cells lived on, preserved in labs in Zaragoza and Madrid. Over the next few years a team of reproductive physiologists led by José Folch injected nuclei from those cells into goat eggs emptied of their own DNA, then implanted the eggs in surrogate mothers. After 57 implantations, only seven animals had become pregnant. And of those seven pregnancies, six ended in miscarriages. But one mother—a hybrid between a Spanish ibex and a goat—carried a clone of Celia to term. Folch and his colleagues performed a cesarean section and delivered the 4.5-pound clone. As Fernández-Arias held the newborn bucardo in his arms, he could see that she was struggling to take in air, her tongue jutting grotesquely out of her mouth. Despite the efforts to help her breathe, after a mere ten minutes Celia's clone died. A necropsy later revealed that one of her lungs had grown a gigantic extra lobe as solid as a piece of liver. There was nothing anyone could have done.

The dodo and the great auk, the thylacine and the Chinese river dolphin, the passenger pigeon and the imperial woodpecker—the bucardo is only one in the long list of animals humans have

THE NEW AGE OF EXPLORATION is a yearlong series of articles celebrating *National Geographic* at 125.



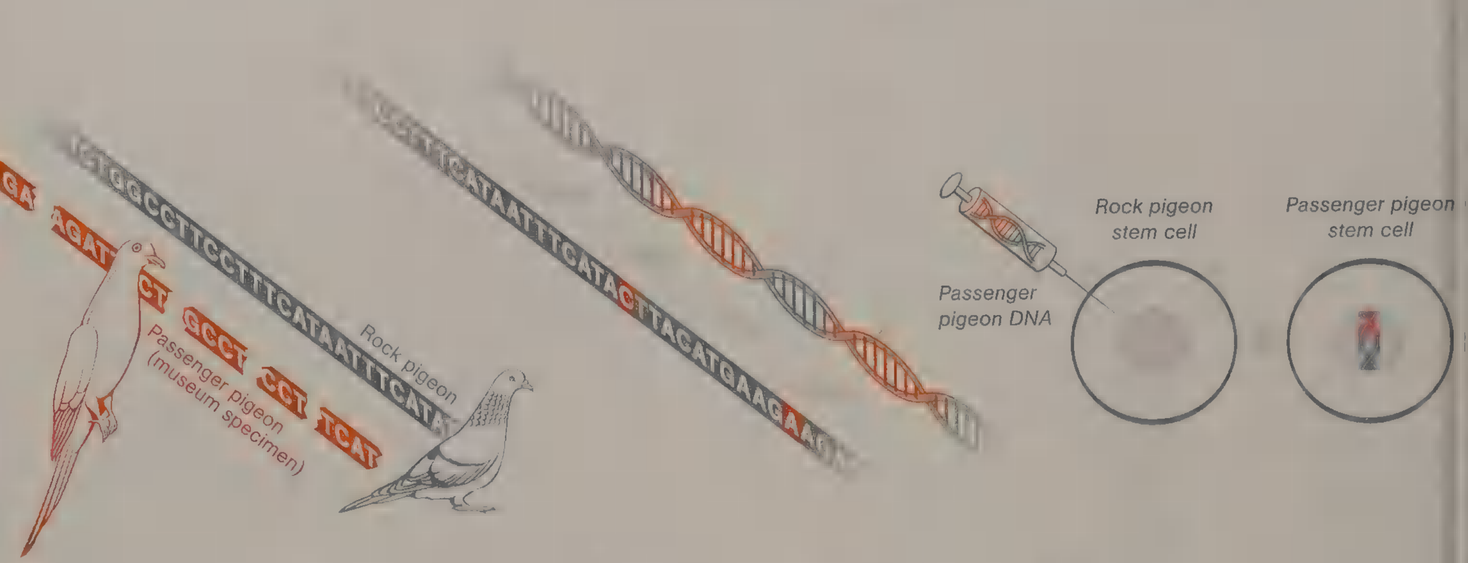
PASSENGER PIGEON
Ectopistes migratorius

Billions of the birds once filled the skies of eastern North America. Martha, the last one (above), died at the Cincinnati Zoo in 1914. Geneticists now think they could resurrect the species.

[illegible] specimen, Smithsonian Institution's National Museum of Natural History, Washington, D.C.

RECIPE FOR RESURRECTION

Can the red-breasted American passenger pigeon, hunted to extinction a century ago, be revived from museum specimens? Yes, say geneticist George Church of Harvard University and his colleagues, by transferring key genes into a living relative.


Passenger pigeon (museum specimen)
Rock pigeon
Passenger pigeon DNA
Rock pigeon stem cell
Passenger pigeon stem cell

1 Assemble a passenger pigeon genome from DNA fragments in museum specimens. Compare with that of the rock pigeon, its streetwise cousin.

2 Identify and synthesize mutations that distinguish the passenger pigeon—that give it a red breast, a longer tail, and other key traits.

3 Swap those bits of DNA for the corresponding bits in rock pigeon stem cells, thus creating passenger pigeon stem cells.

driven extinct, sometimes deliberately. And with many more species now endangered, the bucardo will have much more company in the years to come. Fernández-Arias belongs to a small but passionate group of researchers who believe that cloning can help reverse that trend.

The notion of bringing vanished species back to life—some call it de-extinction—has hovered at the boundary between reality and science fiction for more than two decades, ever since novelist Michael Crichton unleashed the dinosaurs of Jurassic Park on the world. For most of that time the science of de-extinction has lagged far behind the fantasy. Celia's clone is the closest that anyone has gotten to true de-extinction. Since witnessing those fleeting minutes of the clone's life, Fernández-Arias, now the head of the government of Aragon's Hunting, Fishing and Wetlands department, has been waiting for the moment when science would finally catch up, and humans might gain the ability to bring back an animal they had driven extinct.

"We are at that moment," he told me.

I met Fernández-Arias last autumn at a closed-session scientific meeting at the National Geographic Society's headquarters in Washington, D.C. For the first time in history a group of geneticists, wildlife biologists, conservationists, and ethicists had gathered to discuss the possibility of de-extinction. Could it be done? Should it be done? One by one, they stood up to present remarkable advances in manipulating stem cells, in recovering ancient DNA, in reconstructing lost genomes. As the meeting unfolded, the scientists became increasingly excited. A consensus was emerging: De-extinction is now within reach.

"It's gone very much further, very much more rapidly than anyone ever would've imagined," says Ross MacPhee, a curator of mammalogy at the American Museum of Natural History in New York. "What we really need to think about is why we would want to do this in the first place, to actually bring back a species."

In *Jurassic Park* dinosaurs are resurrected for their entertainment value. The disastrous consequences that follow have cast a shadow over the notion of de-extinction, at least in the

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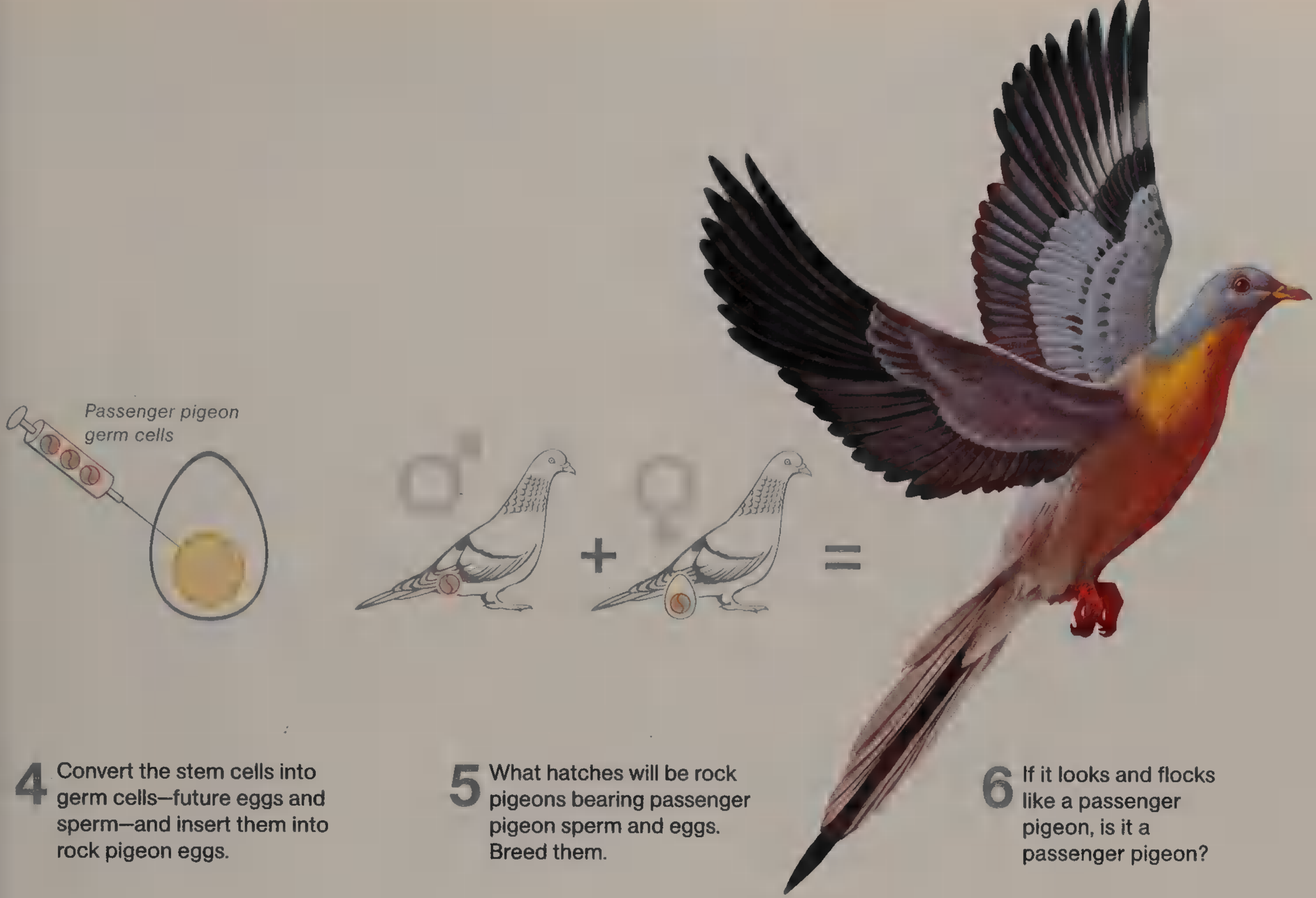
Carl Zimmer's award-winning blog, the Loom, is hosted by National Geographic. *Robb Kendrick also used 19th-century tintype photography in a story on 21st-century cowboys in the December 2007 issue.*



4 Convert the stem cells into germ cells—future eggs and sperm—and insert them into rock pigeon eggs.

5 What hatches will be rock pigeons bearing passenger pigeon sperm and eggs. Breed them.

6 If it looks and flocks like a passenger pigeon, is it a passenger pigeon?

popular imagination. But people tend to forget that Jurassic Park was pure fantasy. In reality the only species we can hope to revive now are those that died within the past few tens of thousands of years and left behind remains that harbor intact cells or, at the very least, enough ancient DNA to reconstruct the creature's genome. Because of the natural rates of decay, we can never hope to retrieve the full genome of *Tyrannosaurus rex,* which vanished about 65 million years ago. The species theoretically capable of being revived all disappeared while humanity was rapidly climbing toward world domination. And especially in recent years we humans were the ones who wiped them out, by hunting them, destroying their habitats, or spreading diseases. This suggests another reason for bringing them back.

"If we're talking about species we drove extinct, then I think we have an obligation to try to do this," says Michael Archer, a paleontologist at the University of New South Wales who has championed de-extinction for years. Some people protest that reviving a species that no longer exists amounts to playing God. Archer scoffs at the notion. "I think we played God when we exterminated these animals."

Other scientists who favor de-extinction argue that there will be concrete benefits. Biological diversity is a storehouse of natural invention. Most pharmaceutical drugs, for example, were not invented from scratch—they were derived from natural compounds found in wild plant species, which are also vulnerable to extinction. Some extinct animals also performed vital services in their ecosystems, which might benefit from their return. Siberia, for example, was home 12,000 years ago to mammoths and other big grazing mammals. Back then, the landscape was not moss-dominated tundra but grassy steppes. Sergey Zimov, a Russian ecologist and director of the Northeast Science Station in Cherskiy in the Republic of Sakha, has long argued that this was no coincidence: The mammoths and numerous herbivores maintained the grassland by breaking up the soil and fertilizing it with their manure. Once they were gone, moss took over and transformed the grassland into less productive tundra.

In recent years Zimov has tried to turn back time on the tundra by bringing horses, muskoxen, and other big mammals to a region of Siberia he calls Pleistocene Park. (See map, page 55.) And he

GRAPHIC: JASON TREAT, NGM STAFF. ART: RAÚL MARTÍN. SOURCES: GEORGE CHURCH; BEN NOVAK, REVIVE AND RESTORE, LONG NOW FOUNDATION; MICHAEL McGREW, ROSLIN INSTITUTE, UNIVERSITY OF EDINBURGH

THYLACINE

Thylacinus cynocephalus

Though it looked like a wolf and was called a Tasmanian tiger, the thylacine was actually a marsupial—a relative of kangaroos and koalas. By the 1930s it had been hunted to extinction.

Taxidermy specimen, American Museum of Natural History, New York would be happy to have woolly mammoths roam free there. "But only my grandchildren will see them," he says. "A mouse breeds very fast. Mammoths breed very slow. Be prepared to wait."

WHEN FERNÁNDEZ-ARIAS first tried to bring back the bucardo ten years ago, the tools at his disposal were, in hindsight, woefully crude. It had been only seven years since the birth of Dolly the sheep, the first cloned mammal. In those early days scientists would clone an animal by taking one of its cells and inserting its DNA into an egg that had been emptied of its own genetic material. An electric shock was enough to get the egg to start dividing, after which the scientists would place the developing embryo in a surrogate mother. The vast majority of those pregnancies failed, and the few animals that were born were often beset with health problems.

Over the past decade scientists have improved their success with cloning animals, shifting the technology from high-risk science to workaday business. Researchers have also developed the ability to induce adult animal cells to return to an embryo-like state. These can be coaxed to develop into any type of cell—including eggs or sperm. The eggs can then be further manipulated to develop into full-fledged embryos.

Such technical sleights of hand make it far easier to conjure a vanished species back to life. Scientists and explorers have been talking for decades about bringing back the mammoth. Their first—and so far only—achievement was to find well-preserved mammoths in the Siberian tundra. Now, armed with the new cloning technologies, researchers at the Sooam Biotech Research Foundation in Seoul have teamed up with mammoth experts from North-Eastern Federal University in the Siberian city of Yakutsk. Last summer they traveled up the Yana River, drilling tunnels into the frozen cliffs along the river with giant hoses. In one of those tunnels they found chunks of mammoth tissue, including bone marrow, hair, skin, and fat. The tissue is now in Seoul, where the Sooam scientists are examining it.

"If we dream about it, the ideal case would be finding a viable cell, a cell that's alive," says Sooam's Insung Hwang, who organized the Yana River expedition. If the Sooam researchers do find such a cell, they could coax it to produce millions of cells. These could be reprogrammed to grow into embryos, which could then be implanted in surrogate elephants, the mammoth's closest living relatives.

Most scientists doubt that any living cell could have survived freezing on the open tundra. But Hwang and his colleagues have a Plan B: capture an intact nucleus of a mammoth cell, which is far more likely to have been preserved than the cell itself. Cloning a mammoth from nothing but an intact nucleus, however, will be a lot trickier. The Sooam researchers will need to transfer the nucleus into an elephant egg that has had its own nucleus removed. This will require harvesting eggs from an elephant—a feat no one has yet accomplished. If the DNA inside the nucleus is well preserved enough to take control of the egg, it just might start dividing into a mammoth embryo. If the scientists can get past that hurdle, they still have the formidable task of transplanting the embryo into an elephant's womb. Then, as Zimov cautions, they will need patience. If all goes well, it will still be almost two years before they can see if the elephant will give birth to a healthy mammoth.

"The thing that I always say is, if you don't try, how would you know that it's impossible?" says Hwang.

IN 1813, while traveling along the Ohio River from Hardensburgh to Louisville, John James Audubon witnessed one of the most miraculous natural phenomena of his time: a flock of passenger pigeons *(Ectopistes migratorius)* blanketing the sky. "The air was literally filled with Pigeons," he later wrote. "The light of noon-day was obscured as by an eclipse, the dung fell in spots, not unlike melting flakes of snow; and the continued buzz of wings had a tendency to lull my senses to repose."

When Audubon reached Louisville before sunset, the pigeons were still passing overhead—

“De-extinction has gone very much further, very much more rapidly than anyone ever would’ve imagined.”

Ross MacPhee, paleontologist

and continued to do so for the next three days. “The people were all in arms,” wrote Audubon. “The banks of the Ohio were crowded with men and boys, incessantly shooting at the pilgrims… Multitudes were thus destroyed.”

In 1813 it would have been hard to imagine a species less likely to become extinct. Yet by the end of the century the red-breasted passenger pigeon was in catastrophic decline, the forests it depended upon shrinking, and its numbers dwindling from relentless hunting. In 1900 the last confirmed wild bird was shot by a boy with a BB gun. Fourteen years later, just a century and a year after Audubon marveled at their abundance, the one remaining captive passenger pigeon, a female named Martha, died at the Cincinnati Zoo.

The writer and environmentalist Stewart Brand, best known for founding the *Whole Earth Catalog* in the late 1960s, grew up in Illinois hiking in forests that just a few decades before had been aroar with the sound of the passenger pigeons’ wings. “Its habitat was my habitat,” he says. Two years ago Brand and his wife, Ryan Phelan, founder of the genetic-testing company DNA Direct, began to wonder if it might be possible to bring the species back to life. One night over dinner with Harvard biologist George Church, a master at manipulating DNA, they discovered that he was thinking along the same lines.

Church knew that standard cloning methods wouldn’t work, since bird embryos develop inside shells and no museum specimen of the passenger pigeon (including Martha herself, now in the Smithsonian) would likely contain a fully intact, functional genome. But he could envision a different way of re-creating the bird. Preserved specimens contain fragments of DNA. By piecing together the fragments, scientists can now read the roughly one billion letters in the passenger pigeon genome. Church can’t yet synthesize an entire animal genome from scratch, but he has invented technology that allows him to make sizable chunks of DNA of any sequence he wants. He could theoretically manufacture genes for passenger pigeon traits—a gene for its long tail, for example—and splice them into the genome of a stem cell from a common rock pigeon.

Rock pigeon stem cells containing this doctored genome could be transformed into germ cells, the precursors to eggs and sperm. These could then be injected into rock pigeon eggs, where they would migrate to the developing embryos’ sex organs. Squabs hatched from these eggs would look like normal rock pigeons—but they would be carrying eggs and sperm loaded with doctored DNA. When the squabs reached maturity and mated, their eggs would hatch squabs carrying unique passenger pigeon traits. These birds could then be further interbred, the scientists selecting for birds that were more and more like the vanished species.

Church’s genome-retooling method could theoretically work on any species with a close living relative and a genome capable of being reconstructed. So even if the Sooam team fails to find an intact mammoth nucleus, someone might still bring the species back. Scientists already have the technology for reconstructing most of the genes it takes to make a mammoth, which could be inserted into an elephant stem cell. And there is no shortage of raw material for further experiments emerging from the Siberian

> **“What intrigues me is just that de-extinction is really cool. A saber-toothed cat? It would be neat to see one of those.”**
>
> *Hank Greely, bioethicist*

WOOLLY MAMMOTH

Mammuthus primigenius

Woolly mammoths retreated to eastern Siberia by the end of the Ice Age, about 10,000 years ago, then died out. A staple of museum dioramas, they’re candidates for rebirth—with elephants as surrogate mothers.

Reconstruction, Natural History Gallery, Royal BC Museum, Victoria, British Columbia

SABER-TOOTHED CAT

Smilodon fatalis

Saber-toothed cats went extinct after the Ice Age; paleontologists are not sure what caused their extinction. This cat was brought to life by a puppeteer: It's a creation of Jim Henson's Creature Shop.

Body model, George C. Page Museum at the La Brea Tar Pits, Los Angeles permafrost. "With mammoths, it's really a dime a dozen up there," says Hendrik Poinar, an expert on mammoth DNA at McMaster University in Ontario. "It's just a matter of finances now."

Though the revival of a mammoth or a passenger pigeon is no longer mere fantasy, the reality is still years away. For another extinct species, the time frame may be much shorter. Indeed, there's at least a chance it may be back among the living before this story is published.

The animal in question is the obsession of a group of Australian scientists led by Michael Archer, who call their endeavor the Lazarus Project. Archer previously directed a highly publicized attempt to clone the thylacine, an iconic marsupial carnivore that went extinct in the 1930s. That effort managed to capture only some fragments of the thylacine's DNA. Wary of the feverish expectations that such high-profile experiments attract, Archer and his Lazarus Project collaborators kept quiet about their efforts until they had some preliminary results to offer.

That time has come. Early in January, Archer and his colleagues revealed that they were trying to revive two closely related species of Australian frog. Until their disappearance in the mid-1980s, the species shared a unique—and utterly astonishing—method of reproduction. The female frogs released a cloud of eggs, which the males fertilized, whereupon the females swallowed the eggs whole. A hormone in the eggs triggered the female to stop making stomach acid; her stomach, in effect, became a womb. A few weeks later the female opened her mouth and regurgitated her fully formed babies. This miraculous reproductive feat gave the frogs their common names: the northern *(Rheobatrachus vitellinus)* and southern *(Rheobatrachus silus)* gastric brooding frogs.

Unfortunately, not long after researchers began to study the species, they vanished. "The frogs were there one minute, and when scientists came back, they were gone," says Andrew French, a cloning expert at the University of Melbourne and a member of the Lazarus Project.

To bring the frogs back, the project scientists are using state-of-the-art cloning methods to introduce gastric brooding frog nuclei into eggs of living Australian marsh frogs and barred frogs that have had their own genetic material removed. It's slow going, because frog eggs begin to lose their potency after just a few hours and cannot be frozen and revived. The scientists need fresh eggs, which the frogs produce only once a year, during their short breeding season.

Nevertheless, they've made progress. "Suffice it to say, we actually have embryos now of this extinct animal," says Archer. "We're pretty far down this track." The Lazarus Project scientists are confident that they just need to get more high-quality eggs to keep moving forward. "At this point it's just a numbers game," says French.

The matchless oddity of the gastric brooding frogs' reproduction drives home what we lose when a species becomes extinct. But does that mean we should bring them back? Would the world be that much richer for having female frogs that grow little frogs in their stomachs? There are tangible benefits, French argues, such as the insights the frogs might be able to provide about reproduction—insights that might someday lead to treatments for pregnant women who have trouble carrying babies to term. But for many scientists, de-extinction is a distraction from the pressing work required to stave off mass extinctions.

"There is clearly a terrible urgency to saving threatened species and habitats," says John Wiens, an evolutionary biologist at Stony Brook University in New York. "As far as I can see, there is little urgency for bringing back extinct ones. Why invest millions of dollars in bringing a handful of species back from the dead, when there are millions still waiting to be discovered, described, and protected?"

De-extinction advocates counter that the cloning and genomic engineering technologies being developed for de-extinction could also help preserve endangered species, especially ones that don't breed easily in captivity. And though cutting-edge biotechnology can be expensive when it's

“The thing that I always say is, if you don’t try, how would you know that it’s impossible?”

Insung Hwang, cloning expert

first developed, it has a way of becoming very cheap very fast. “Maybe some people thought polio vaccines were a distraction from iron lungs,” says George Church. “It’s hard in advance to say what’s distraction and what’s salvation.”

But what would we be willing to call salvation? Even if Church and his colleagues manage to retrofit every passenger pigeon–specific trait into a rock pigeon, would the resulting creature truly be a passenger pigeon or just an engineered curiosity? If Archer and French do produce a single gastric brooding frog—if they haven’t already—does that mean they’ve revived the species? If that frog doesn’t have a mate, then it becomes an amphibian version of Celia, and its species is as good as extinct. Would it be enough to keep a population of the frogs in a lab or perhaps in a zoo, where people could gawk at it? Or would it need to be introduced back into the wild to be truly de-extinct?

“The history of putting species back after they’ve gone extinct in the wild is fraught with difficulty,” says conservation biologist Stuart Pimm of Duke University. A huge effort went into restoring the Arabian oryx to the wild, for example. But after the animals were returned to a refuge in central Oman in 1982, almost all were wiped out by poachers. “We had the animals, and we put them back, and the world wasn’t ready,” says Pimm. “Having the species solves only a tiny, tiny part of the problem.”

Hunting is not the only threat that would face recovered species. For many, there’s no place left to call home. The Chinese river dolphin became extinct due to pollution and other pressures from the human population on the Yangtze River. Things are just as bad there today. Around the world frogs are getting decimated by a human-spread pathogen called the chytrid fungus. If Australian biologists someday release gastric brooding frogs into their old mountain streams, they could promptly become extinct again.

“Without an environment to put re-created species back into, the whole exercise is futile and a gross waste of money,” says Glenn Albrecht, director of the Institute for Social Sustainability at Murdoch University in Australia.

Even if de-extinction proved a complete logistical success, the questions would not end. Passenger pigeons might find the rebounding forests of the eastern United States a welcoming home. But wouldn’t that be, in effect, the introduction of a genetically engineered organism into the environment? Could passenger pigeons become a reservoir for a virus that might wipe out another bird species? And how would the residents of Chicago, New York, or Washington, D.C., feel about a new pigeon species arriving in their cities, darkening their skies, and covering their streets with snowstorms of dung?

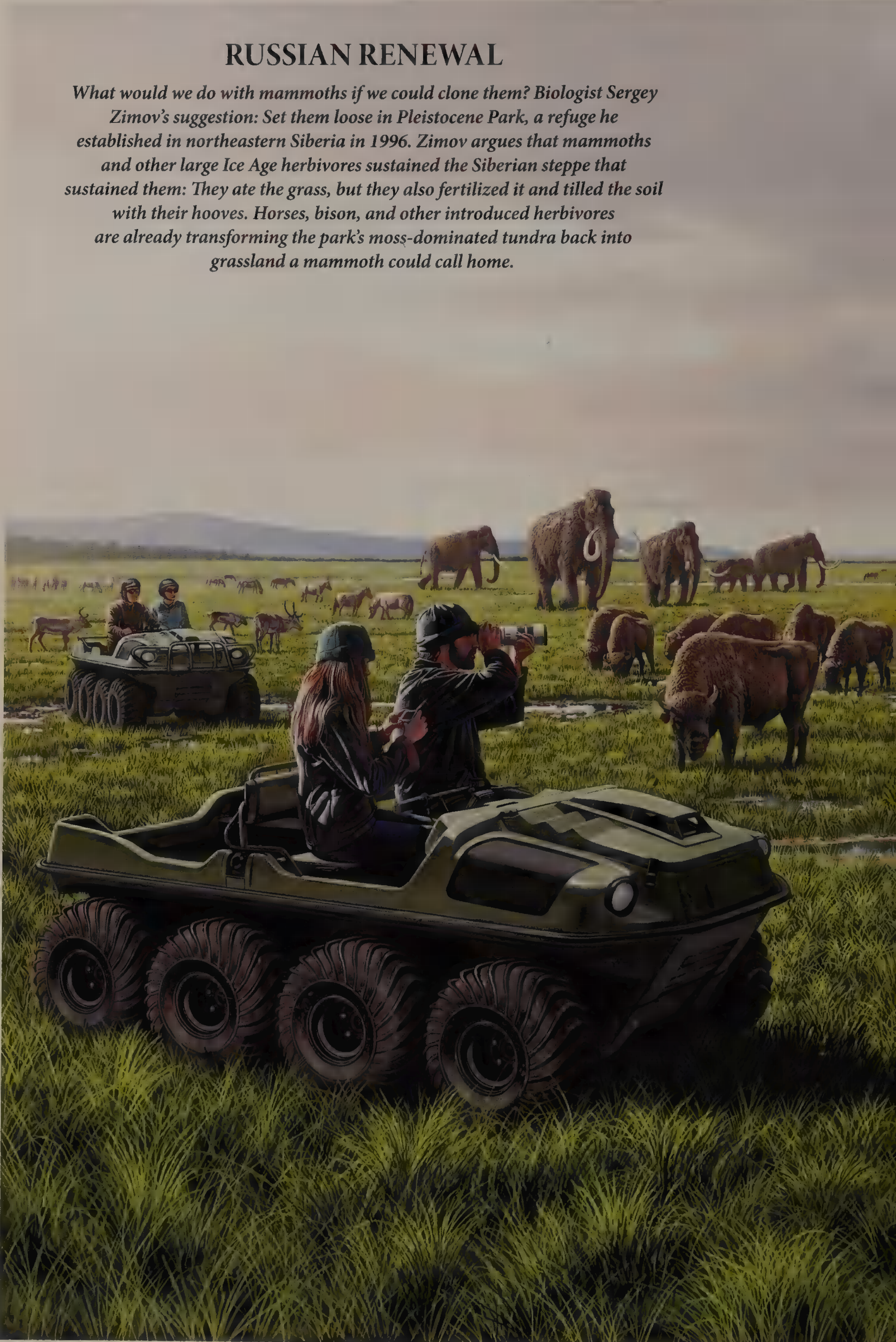
De-extinction advocates are pondering these questions, and most believe they need to be resolved before any major project moves forward. Hank Greely, a leading bioethicist at Stanford University, has taken a keen interest in investigating the ethical and legal implications of de-extinction. And yet for Greely, as for many others, the very fact that science has advanced to the point that such a spectacular feat is possible is a compelling reason to embrace de-extinction, not to shun it.

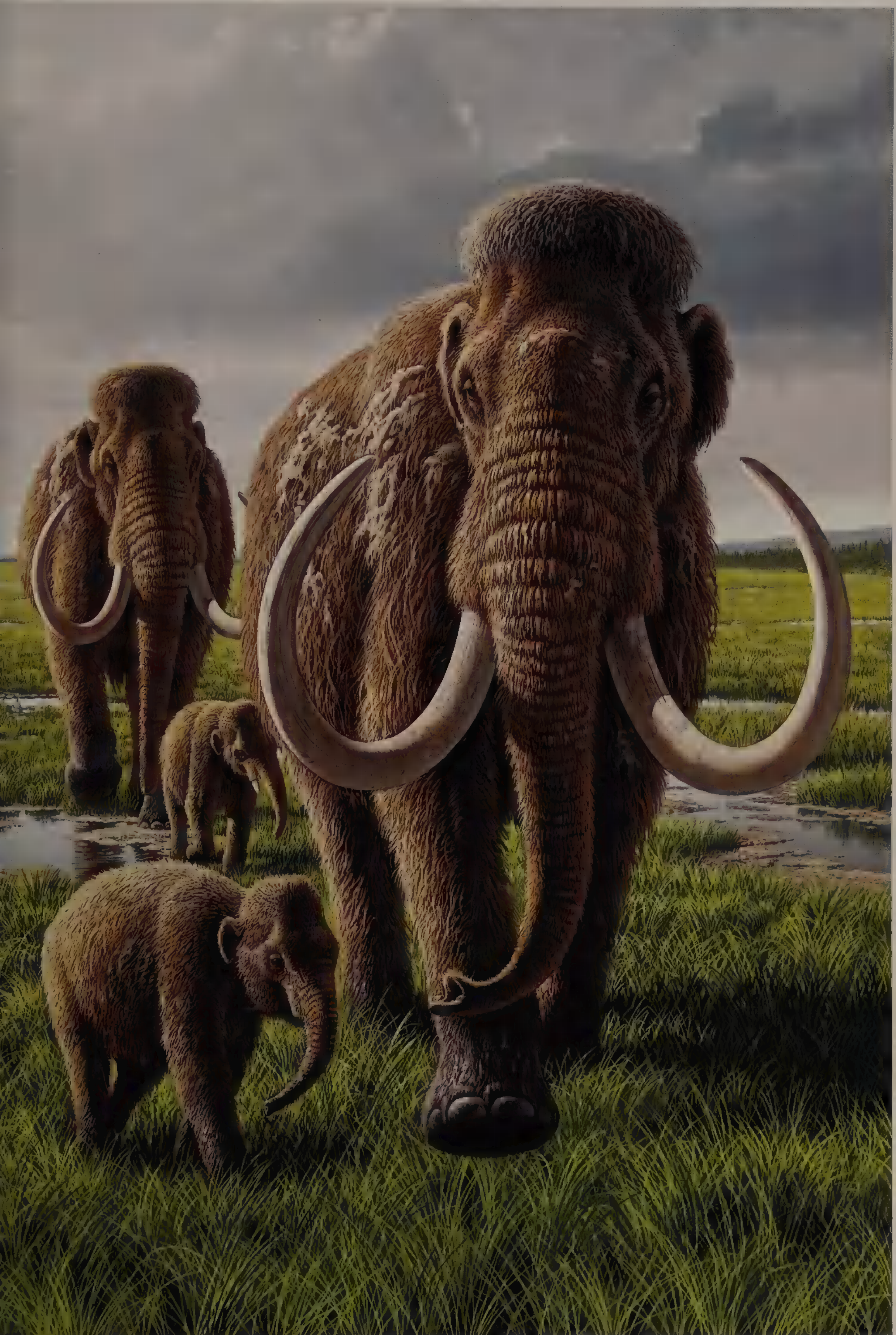
“What intrigues me is just that it’s really cool,” Greely says. “A saber-toothed cat? It would be neat to see one of those.” □

Check out film footage of the last of their kinds, interviews with scientists, and more on our digital editions.

RUSSIAN RENEWAL

What would we do with mammoths if we could clone them? Biologist Sergey Zimov's suggestion: Set them loose in Pleistocene Park, a refuge he established in northeastern Siberia in 1996. Zimov argues that mammoths and other large Ice Age herbivores sustained the Siberian steppe that sustained them: They ate the grass, but they also fertilized it and tilled the soil with their hooves. Horses, bison, and other introduced herbivores are already transforming the park's moss-dominated tundra back into grassland a mammoth could call home.

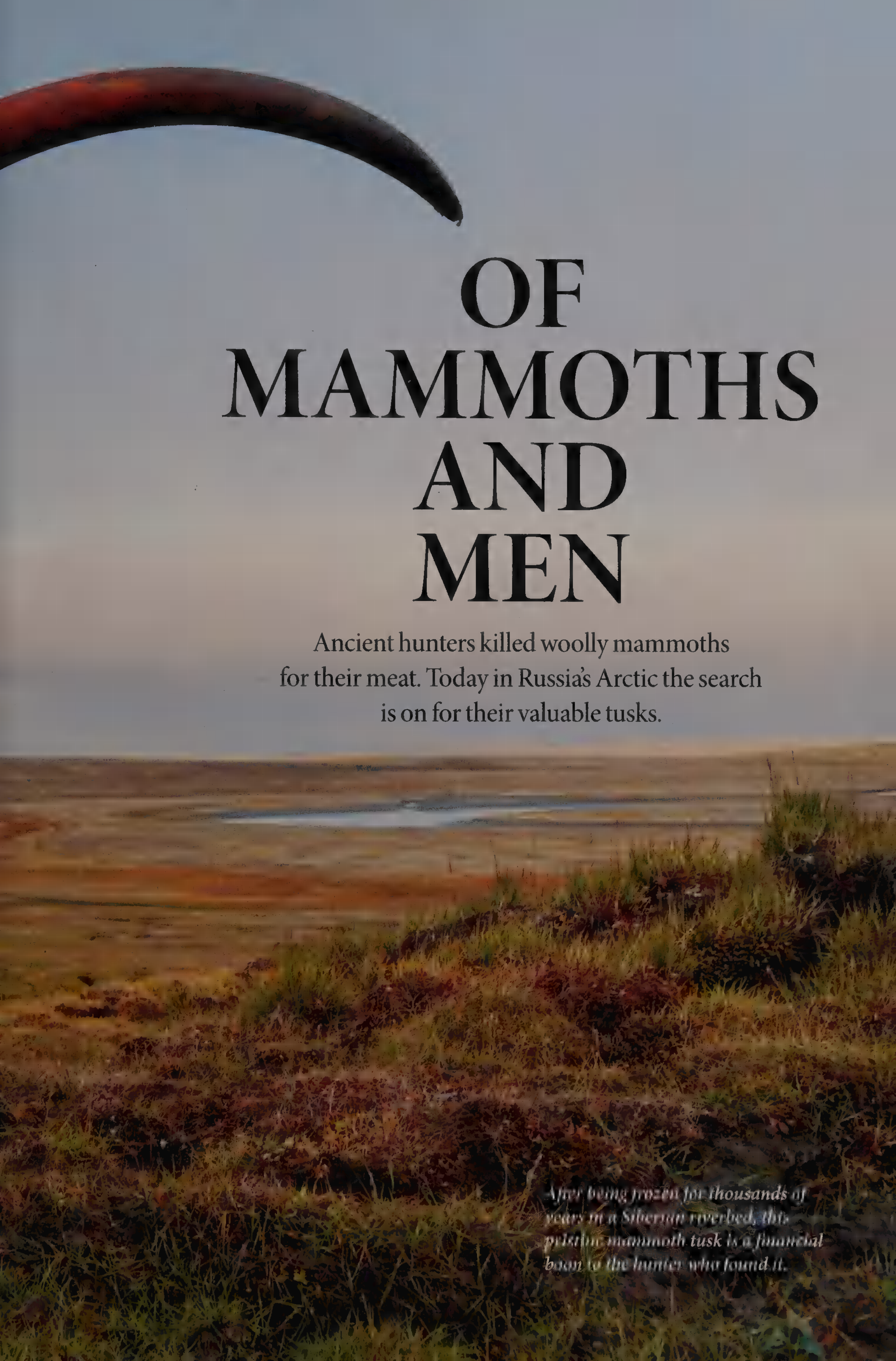




ART: RAÚL MARTÍN. SOURCE: SERGEY ZIMOV, NORTHEAST SCIENCE STATION; NIKITA ZIMOV, PLEISTOCENE PARK

BY BROOK LARMER

PHOTOGRAPHS
BY EVGENIA ARBUGAEVA



OF MAMMOTHS AND MEN

Ancient hunters killed woolly mammoths for their meat. Today in Russia's Arctic the search is on for their valuable tusks.

After being frozen for thousands of years in a Siberian riverbed, this pristine mammoth tusk is a financial boon to the hunter who found it.

A few years ago tusk hunters from the village of Yukagir found this ginger-haired juvenile mammoth, nicknamed Yuka, in an ice cliff. As hunters proliferate, the pace of discoveries is accelerating.

A tusk hunter scours the coast of Bolshoy Lyakhovskiy Island. Lured by rising prices for mammoth ivory, hundreds of men cross the frozen Arctic seas each spring to search for it along eroding shorelines.

From the bone pile outside a makeshift bathhouse (right) near Lake Bustakh, Vladimir Potapov raises the skull of a prehistoric bison. The valuable tusks of the mammoth, sketched by fellow hunter Lev Nikolaevich, serve as northern Yakutiya's economic lifeline.

One last chance. That's all the Siberian hunter wants.

For five months Karl Gorokhov has tracked his ancient prey across a desolate island in the East Siberian Sea, slogging 18 hours a day over the icy tundra. He is cold and exhausted, with a hunger so primal that he has been reduced to eating seagulls. Even the two polar bears that attacked his camp were famished; their stomachs, slit open after they were shot dead, were empty. Gorokhov, a 46-year-old with wind-chapped cheeks and a scraggly, reddish beard, heads out every day past the nine graves near his camp—the final resting places, he presumes, for unlucky souls who came to the island to escape the Soviet gulag.

Gorokhov is running out of time. Late summer blizzards are howling across Kotelnyy Island, 600 miles north of the Arctic Circle, and the deep freeze of another northern winter looms. His fingers and palms start to itch. It's "a lucky sign," Gorokhov said later. The itching usually strikes when he's on the verge of finding what he's looking for: the ivory tusks of a mammoth.

The shaggy giants that roamed northern Siberia during the late Pleistocene epoch died off about 10,000 years ago, though isolated populations lingered on islands to the north and east, the last dying out some 3,700 years ago. The mammoths' tusks, which could spiral to more than 13 feet, are reemerging from the permafrost—and fueling a trade that benefits the people of Arctic Siberia, including the native Yakuts, an Asiatic ethnic group that speaks a language of Turkic origin. For nearly a decade Gorokhov has been a tusk-hunting pioneer, exploring one of the world's most inhospitable expanses. Now, trusting his itchy fingers, he scours the tundra until he almost trips over the tip of a tusk. "Sometimes the tusk just appears in front of you," he says, "as if it were guiding you all along."

It takes Gorokhov almost 24 hours of continuous digging to extract the tusk from the pebbly ice below. The specimen that emerges is as thick as a tree trunk—150 pounds—and in near-pristine condition. Before hauling the tusk away, Gorokhov tosses a silver earring into the hole he has dug, as an offering to the local spirits. If he gets the ancient relic safely home, it could fetch more than $60,000.

THE TRADE IN MAMMOTH ivory barely existed when Gorokhov was born in northern Siberia in 1966, on the same day, May 5, as his namesake, Karl Marx. He remembers as a child seeing rotting tusks on the banks of the Yana River, near his fishing village of Ust-Yansk. Free enterprise was banned in the Soviet Union, and many locals considered it bad luck to disturb the tusks, which some believed came from giant molelike creatures that lived deep under the permafrost.

Still, the ancient tusks held Gorokhov in their spell. Growing up in Yakutiya, a resource-rich region nearly the size of India that's inhabited today by fewer than a million people and is officially called the Republic of Sakha, he was told that the Earth's creator got so cold flying over this region that he dropped a wealth of treasures: gold, silver, diamonds, oil. But it was his schoolteachers' real-life stories about 17th-century pioneers trading in mammoth tusks that captivated Gorokhov. Years later he would find library books with photographs of early 20th-century explorers: bearded men standing on Kotelnyy Island, dwarfed by mammoth tusks,

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Brook Larmer wrote about China's terra-cotta warriors in June 2012. Evgenia Arbugaeva grew up in Yakutsk, a hub of the mammoth tusk trade.

Tusk hunters share a meal under a mammoth's gaze in a cabin near Lake Bustakh. Hunger sets in as rations dwindle near the end of the five-month season. By fall many men will have lost 20 pounds or more.

Millions of mammoth tusks, perhaps more, are still locked i

their boats groaning with stacks of ivory. "I always wondered if more tusks were out there," Gorokhov says.

Nobody, not even Gorokhov, imagined that mammoth tusks would become an economic lifeline for a region that had been largely abandoned after the shuttering of Soviet-era mines and factories. (The population of Yakutiya's Ust-Yanskiy District, which covers a swath of tundra three times the size of Switzerland, has dropped from 80,000 to just 8,000 in the past five decades.) Now hundreds, if not thousands, of Yakutiyan men have become tusk hunters, following their ancestors' routes, enduring the same brutal conditions—and chasing the same Paleolithic beasts.

As primitive as it may seem, the tusk rush is driven not by ancient callings but by powerful modern forces: the collapse of the Soviet Union and the ensuing frenzy of frontier capitalism, the international ban on trading elephant ivory and the search for alternatives, even the advent of global warming. Rising temperatures helped seal the mammoths' fate near the end of the last ice age by shrinking and drowning their grassland habitats, leaving herds stranded on the isolated islands where Gorokhov now hunts. Today the thawing and erosion of the mammoth's permafrost graveyard—and the rush of tusk hunters—are helping bring them back. Long after the first largely intact specimens were pulled out of the Siberian tundra in the 1800s, the drumbeat of discoveries is quickening. In September 2012 an 11-year-old boy on Russia's Taymyr Peninsula stumbled upon a well-preserved adolescent mammoth, one of its ancient limbs sticking out of the half-frozen sediment.

Nothing, however, has fueled the mammoth tusk trade more than the rise of China, which has an ivory-carving tradition going back thousands of years. Nearly 90 percent of all mammoth tusks hauled out of Siberia—estimated at more than 60 tons a year, though the actual figure may be higher—end up in China, where legions of the newly rich are entranced by ivory. The spike in demand has worried some scientists, who lament the loss of valuable data; like the trunk of a tree, a tusk contains clues about diet, climate, and the environment. Even Yakutiyans wonder how quickly this nonrenewable resource will be depleted. Millions of mammoth tusks, perhaps more, are still locked in Siberia's permafrost, but already they're becoming harder to find.

It was hoped that mammoth ivory would ease the pressure on a far more endangered resource: elephants. Mammoth ivory is legal, even if the trade is poorly regulated. The two kinds of ivory, moreover, can be distinguished by tusk patterns known as Schreger lines. Their prices are also roughly equivalent. Still, there are no signs yet that Asian demand for elephant ivory is flagging. On the contrary, the slaughter of African elephants has intensified, and in 2012 Hong Kong customs officials seized a record six tons of elephant ivory. Further complicating the issue is that illegal elephant ivory and legal mammoth ivory often end up in the same carving workshops in China.

None of the tusk hunters I meet during an expedition to northern Yakutiya have ever traveled beyond the Siberian tundra. Yet they are all keenly aware of Chinese demand, which has doubled the price of top-grade mammoth tusks to around $400 a pound in Yakutsk, the regional capital, in the past two years. The price can double again across the Chinese border, and a finely carved full-length tusk can cost a king's ransom. At an antiques shop in Hong Kong, I saw a ten-foot-long mammoth tusk carved with an intricate bacchanalian scene selling for $1.1 million. When tusk hunters discover that I live in Beijing, they sidle up with the same question: "Could you get me in touch with some Chinese buyers?"

ALL ACROSS YAKUTIYA the search is on. In the village of Kazachye, a hub of the trade on the Yana River, tusk hunters prepare to cross the tundra on snowmobiles, hydrofoil boats, even Soviet-era all-terrain vehicles with tank treads. At a remote glacial lake I'm probing the ancient mud and ice along the eroding shoreline with a crew of tusk hunters when a shivering young man emerges from the frigid water in a scuba

Siberia's permafrost, but they're becoming harder to find.

suit and mask—another hunter looking for an edge. Farther along the Yana a pair of men blast water from hoses at a cliff face of blackened ice, boring tunnels into a frozen repository of mammoth tusks, bones, and carcasses.

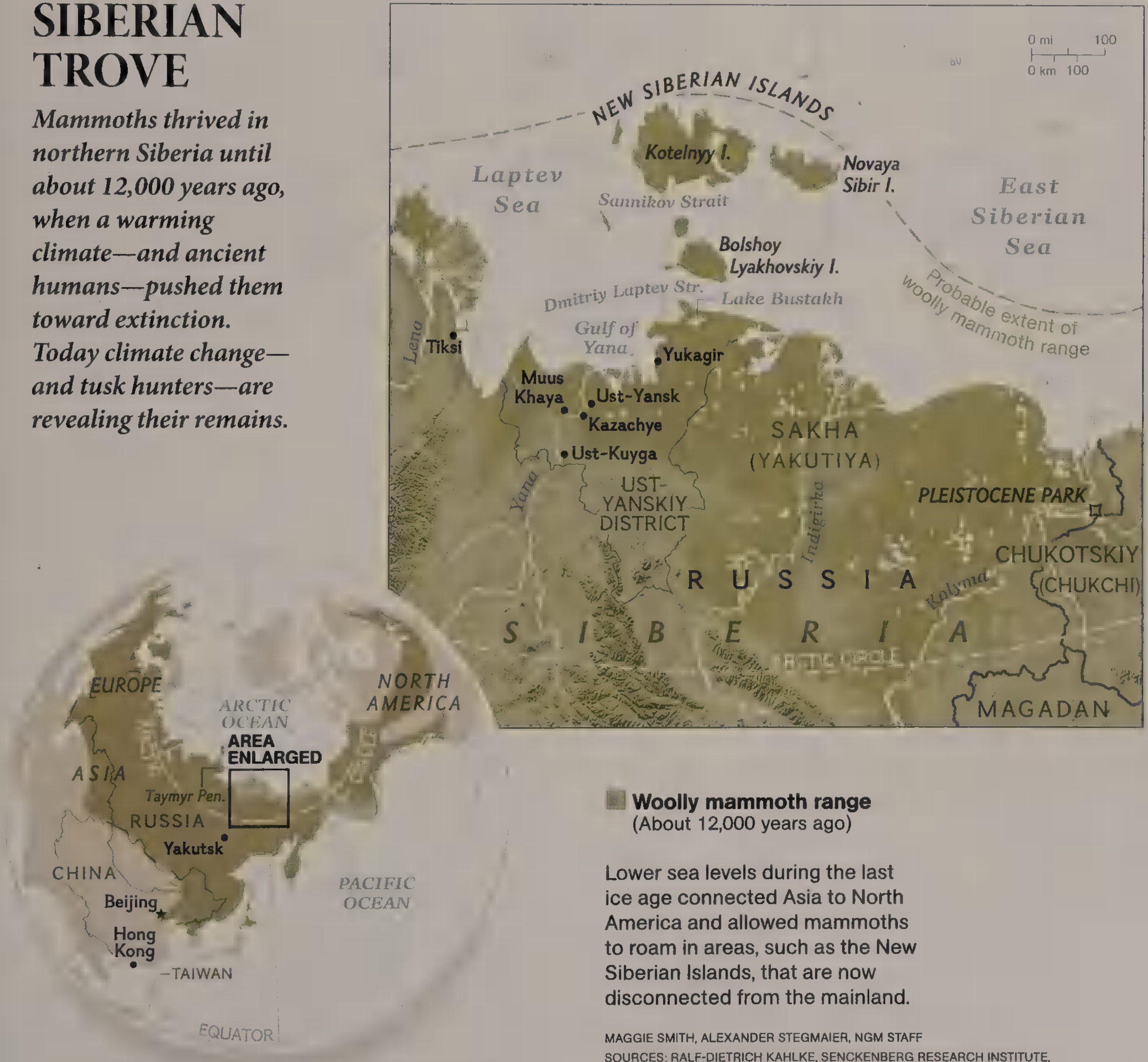
I've arrived at this place, Muus Khaya, with a tusk-hunting boss who captains his boat from atop a 900-pound pile of mammoth tusks. He's taking the ivory upriver to sell, but first he wants to visit the ice caves, where a team of Russian and South Korean scientists is extracting soft mammoth tissue in hopes of finding viable cells to clone. (See "Bringing Them Back to Life," page 28.) A few years ago this local boss found several dozen tusks in a single ice cave here. But today his crew is downcast. The men have found only two tusks all summer—not nearly enough to get their families through winter. "This place is tapped out," says one of the tusk hunters. "That's why everybody is heading to the islands."

Inspired by the explorers in those old library-book photos, Gorokhov was among the first tusk hunters, nearly a decade ago, to stay for a full season on the uninhabited

(Continued on page 62)

SIBERIAN TROVE

Mammoths thrived in northern Siberia until about 12,000 years ago, when a warming climate—and ancient humans—pushed them toward extinction. Today climate change—and tusk hunters—are revealing their remains.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NEW SIBERIAN ISLANDS
Kotelnyy I.
Novaya Sibir I.
Laptev Sea
Sannikov Strait
East Siberian Sea
Bolshoy Lyakhovskiy I.
Dmitriy Laptev Str.
Lake Bustakh
Probable extent of woolly mammoth range
Lena
Tiksi
Gulf of Yana
Yukagir
Muus Khaya
Ust-Yansk
Kazachye
Ust-Kuyga
SAKHA (YAKUTIYA)
Yana
UST-YANSKIY DISTRICT
Indigirka
PLEISTOCENE PARK
CHUKOTSKIY (CHUKCHI)
Kolyma
R U S S I A
S I B E R I A
ARCTIC CIRCLE
MAGADAN
EUROPE
ARCTIC OCEAN
NORTH AMERICA
AREA ENLARGED
ASIA
Taymyr Pen.
RUSSIA
Yakutsk
CHINA
Beijing
Hong Kong
TAIWAN
PACIFIC OCEAN
EQUATOR

▨ **Woolly mammoth range**
(About 12,000 years ago)

Lower sea levels during the last ice age connected Asia to North America and allowed mammoths to roam in areas, such as the New Siberian Islands, that are now disconnected from the mainland.

MAGGIE SMITH, ALEXANDER STEGMAIER, NGM STAFF
SOURCES: RALF-DIETRICH KAHLKE, SENCKENBERG RESEARCH INSTITUTE, WEIMAR, GERMANY; DANIEL FISHER, UNIVERSITY OF MICHIGAN

Slava Dolbaev uses a spear to dig out a corkscrewed tusk from a coastal ice cliff. Prying loose a single tusk can take hours, even days. Tusk hunters often leave colored beads or silver jewelry as offerings to local spirits.

Hunters unload tusks on Siberia's northern coast, where they'll await transport up the Yana River. A good tusk can support a family through a long winter, but some hunters return empty-handed.

Mikhail Milyutin gazes at his haul on Bolshoy Lyakhovskiy Island. His hut is camouflaged against the helicopters of the Russian border guards, who last summer ousted dozens of hunters for lacking proper permits.

The journey from permafrost to market begins by small boat (above). Some 90 percent of tusks go to China, whose ivory-carving tradition dates back thousands of years. Carvers in this shop in Guangdong Province can spend five years on one piece, which might sell for a million dollars. Dashing hopes, availability of legal mammoth ivory has not reduced demand for illegal elephant ivory.

New Siberian Islands off the Arctic coast. Just getting to the islands means traversing a 35-mile ice bridge across the sea in spring, then staying on the island until the ocean freezes over again six months later—or riding home earlier on small boats that can get engulfed by 15-foot waves.

If the mainland is perilous—Gorokhov says he once spent eight months lost on the tundra—the islands are far worse. Beyond the hunger and exhaustion, the polar bear attacks, and the deaths of four colleagues last summer, Gorokhov faced the hazard of Russian border guards. Swooping in on helicopter patrols, they kicked dozens of tusk hunters off the islands for lacking the proper permits, often destroying their equipment and confiscating their tusks. "You get very skilled at hiding your tusks and lying very still in the tundra," Gorokhov says.

The tusks make it worth the risk. After a couple of expeditions to Bolshoy Lyakhovskiy Island, where Gorokhov found spectacular specimens in the seaside bluffs, he has moved on to the more distant Kotelnyy Island. Even now, as hundreds of others have rushed to join him, Gorokhov keeps a step ahead. "I've been doing this so long I almost think like a paleontologist," he says. On Kotelnyy he's noticed that as the permafrost thaws and settles each summer, mammoth tusks resting on a layer of ice below begin to peek out of the tundra. "Every year there's another crop," he says.

IT IS ALMOST MIDNIGHT at Gorokhov's home along the Yana River, some 50 miles south of where it flows into the Laptev Sea. The embers of a September sunset streak the horizon orange—they will linger all night at this latitude—and the ghostly green lights of the aurora borealis are starting to dance across the sky. Gorokhov, just back to Ust-Yansk after his five-month island

expedition, leads me to a wooden shed behind the house. Inside are nearly two dozen mammoth tusks, some wrapped in white cloth, others—including the 150-pounder he found that day on Kotelnyy—immersed in water in a large aluminum tub. "If the tusks are exposed to air, they start to crack," Gorokhov explains. "I have to keep them in good condition. They are my future."

The tusks in the tub—Gorokhov's summer haul—weigh a total of 1,100 pounds. Most three-man crews bring back barely half that amount, while some wander the tundra for five months and find nothing at all. Gorokhov is also fortunate that he now has enough resources—boat, snowmobile, satellite phone, GPS—to operate independently. Many tusk hunters work for a salary or a small percentage of the profits. With prices so high, this will surely be Gorokhov's most lucrative haul—worth anywhere from $150,000 to $300,000. But he's in no hurry to sell locally. If he waits until winter ice-fishing season, he'll be able to transport them up the frozen river and then by road to Yakutsk, where prices are 40 percent higher.

Gorokhov's wife, Sardaana, and their five-year-old daughter are waiting for him in Yakutsk. He hasn't seen them in six months. "When I get back, my wife will stroke my beard for one night and then demand that I shave it off," he says. This may be the last time he hunts for tusks. "I haven't seen a real summer in a decade," he says. "I have this dream of traveling to some exotic country like India or Vietnam." Gorokhov has never left Yakutiya. Even mild temperatures make him sweat profusely. There's another factor that may make him postpone his vacation plans. "My wife is always telling me to stop," he says. "But when she sees how much I found this summer, she'll be pushing me to go back out again." □

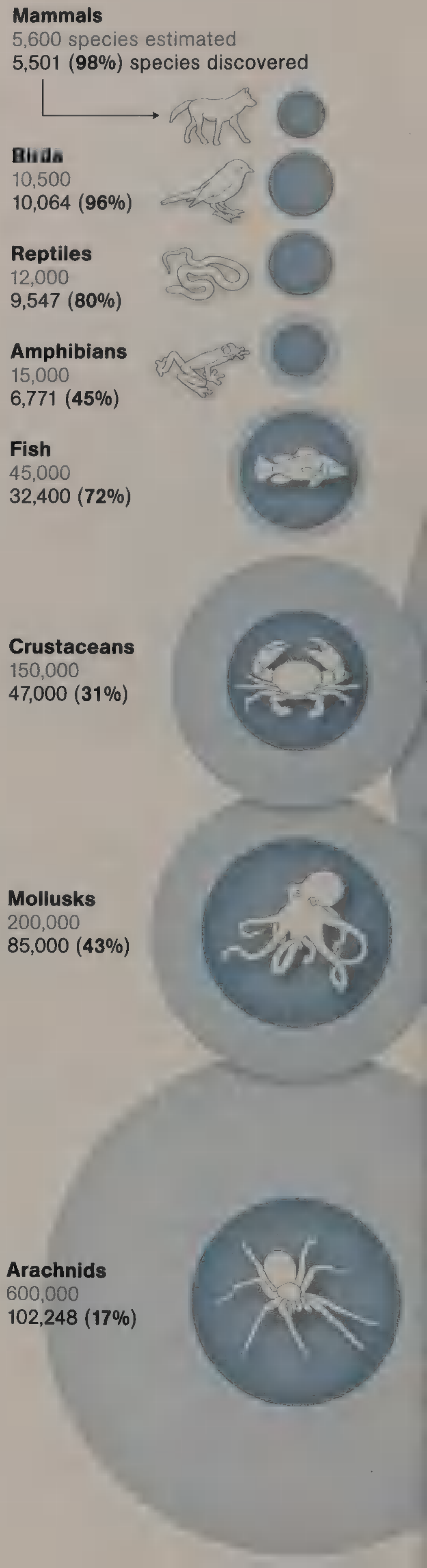
Species Hunt

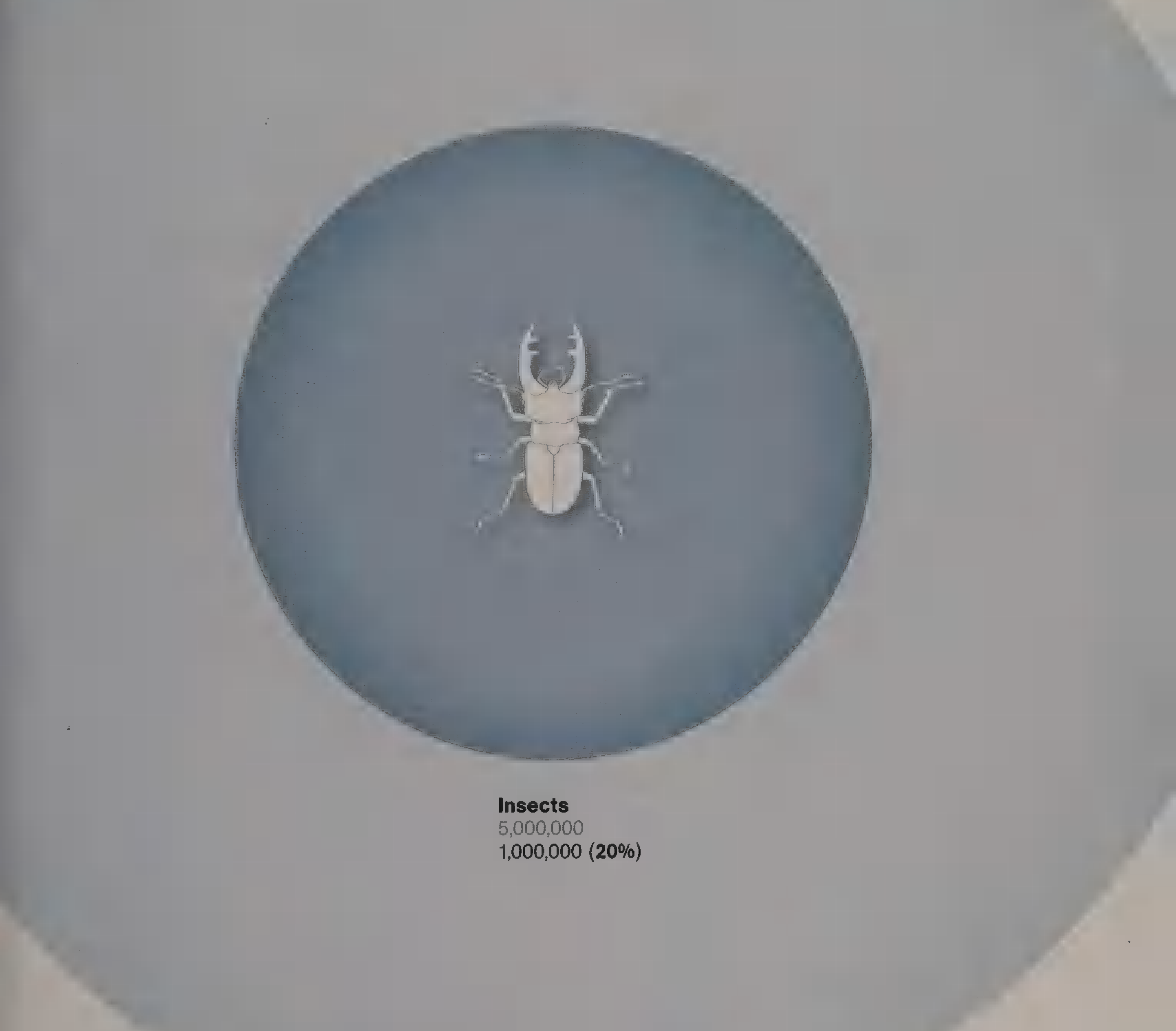
A HUNGRY GUIDE caught a foot-long catfish in a Suriname river in 2010 and began to gut it. But the fish didn't turn into a fillet—rather, it turned out to be an undiscovered species. The guide was part of a Conservation International–led survey of a tropical forest. Scientists rescued the specimen just in time when they noticed its exceptionally long spines, likely meant to fend off giant piranhas. Unlike any catfish in reference books, the as yet unnamed fish was one of 46 candidates for new species status found within three weeks. "They're all pieces of a big puzzle," says expedition member Philip Willink. "The more we have, the better our understanding of how the whole world works."

In the 1730s Swedish botanist Carl Linnaeus set out rules for classifying species, the most basic biological category: a group of living things that look alike and normally mate only with each other. Since then, scientists have cataloged more than 1.7 million. But there's still a lot of work to be done. Estimates of the total number of species range from 3 million to 100 million; one new study puts the figure at 8.7 million, give or take a million. The numbers at right, compiled from many surveys and statistical projections, offer the best guess for species in selected categories.

As these examples illustrate, most vertebrates have been identified, but many invertebrates—especially insects—remain for future generations of explorers to discover.

—A. R. Williams





5W INFOGRAPHICS; ALEXANDER STEGMAIER, NGM STAFF
SOURCES: IUCN; ARTHUR D. CHAPMAN, AUSTRALIAN BIODIVERSITY INFORMATION SERVICES

By Pat Walters Photograph by Marco Grob

Crusading Pilot

BARRINGTON IRVING became the youngest person (and first African American) to fly solo around the world when the 23-year-old landed in Miami on June 27, 2007. The former high school football star had been studying aviation for only a year when he went after sponsors to help him assemble a single-engine plane for the 27,000-mile journey. Irving says he took on the trip to inspire young people to grow stronger by testing the limits of their capabilities. Today he is both a pilot and a teacher, using his experience to encourage kids in Florida to explore the skies.

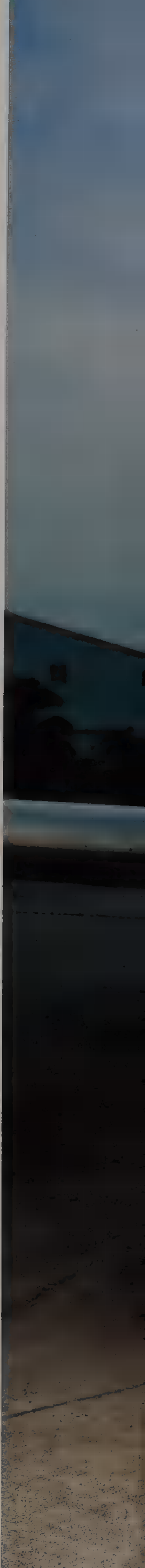
Why do you fly?
What fires me up about flying is that you're between heaven and Earth. Your life is suspended in midair. So much precision is required. There is nothing else I can think of that creates such an adrenaline rush and at the same time brings so much peace.

Tell me about a time when you had that mix of feelings.
Every time I tell this story I get goose bumps. I left northern Japan and had to fly to a tiny island called Shemya, Alaska [on the Pacific leg of the round-the-world flight]. It was a very turbulent flight, winds from 70-something knots to 110, blowing everywhere from all directions. The last three hours, a major ice storm was born. I remember airline pilots radioing me, asking what the hell am I doing down there. And they were like, You have to turn back. And here I am flying this single-engine airplane. I said, "I don't have enough fuel to turn back." So these guys asked for my parents' name and phone number. They said there was no way to make it. When I landed on Shemya Island, I had 12 minutes of fuel left in my tank. That was when I knew I was called to do this stuff.

You run a school where kids can pursue science and engineering.
We had students build an airplane from scratch. I said I'd fly it. You hear them while they're building it: "Oh, I think I did this wrong," or "I need help with this!" After I took off, it really hit me that I'm flying something the kids made. I'm thinking, What happens if the engine quits?

But it flew?
Oh yeah. It flew great.

Marco Grob's video interview with Barrington Irving can be viewed on our digital editions.



History's Backyard

America's first state celebrates its "founding river" and more.

BY ADAM GOODHEART

PHOTOGRAPHS BY MICHAEL MELFORD

Du Pont descendants still live in the 1923 Granogue mansion, one of many grand estates that have preserved a lush natural corridor along the Brandywine River in Delaware. Portions of the corridor form the backbone of a proposed park.

The Brandywine River powered American industry in the 19th century. Walker's textile mill joins many others that dot the riverbanks. Upstream, the DuPont Company made gunpowder; other mills produced everything from paper to snuff.

A reenactor seeks shade during the Battle of Brandywine.

On a dreary stretch of Interstate 95, shadowed by the corporate office towers of Wilmington, Delaware, an overpass spans a narrow valley. Passing motorists, zooming through on their way toward Baltimore or Philadelphia, might cross a hundred times and barely notice the gorge's existence: hardly more than a wrinkle in the landscape, a glimpse of treetops vanishing in the rearview mirror. They would hardly guess at the little world enfolded within it, much less that it conceals what is arguably one of America's great waterways.

The Brandywine River is not, to be sure, the Mississippi, the Colorado, or the Hudson. It has inspired no epic novels, gouged no mighty canyons, carried on its bosom no famous ships. Indeed, in most places the Brandywine is navigable only by canoe or kayak, and you can easily skip a stone from one shore to the other. Its main stem is a mere 20 miles long, and for several centuries geographers have disagreed over whether it is a river at all or merely a creek. Yet no one could dispute that throughout those centuries, this bantam-size stream has consistently punched far above its weight. The Brandywine has powered technological revolutions, fueled gold rushes and wars, dazzled famous artists. A battle for the young nation's survival was fought on its muddy banks.

Today the Brandywine is drawing new attention thanks to a tract of land alongside it that may become the core of a new national monument: the 400th unit of the National Park System and the first within the state of Delaware. If proponents prevail, the rest of the country will finally notice the Brandywine—and the outsize course that it has cut through American history.

At 50 yards' distance, the Brandywine's brown surface often appears still, almost stagnant. Draw closer, though, and you realize that it is moving fast. You are rarely out of earshot of the

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Adam Goodheart is the author of 1861: The Civil War Awakening. *Michael Melford is a regular contributor to* National Geographic.

chatter of water passing over smooth stones or of its soughing as it tumbles down a milldam.

Waterpower: That one word sums up the long history of this river. From its source waters in the sandstone hills of southern Pennsylvania, the river falls seaward down a series of sloping planes. Except when in flood, this is not a whitewater river; it gathers its force not in headlong rushes but with a steady, businesslike insistence. In the final ten miles or so before its mouth, it drops 160 feet before plunging over low falls and feeding the deepwater harbor at Wilmington.

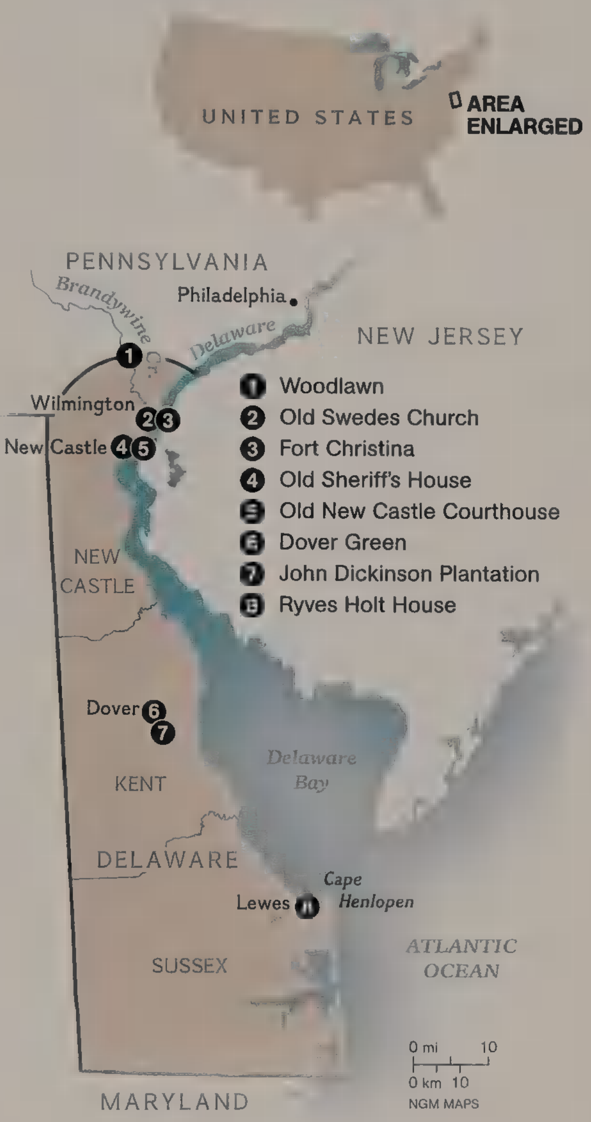
For much of its length, the Brandywine gorge's steeply wooded flanks are lined with the imposing remnants of a vanished society—although many of the ruins are little more than a century old. They are relics of the era when America's industrial and technological revolutions were powered by water. The Brandywine is just strong enough and just gentle enough, just narrow enough and just shallow enough, and just close enough to several great Atlantic ports to have made it the perfect incubator of industry.

At Hagley, an area not far from downtown Wilmington and the river's mouth, a row of what look like massive granite mausoleums juts into the stream. Inside these stone buildings, rusted machinery lies in neat rows, like stacked sarcophagi from the Iron Age. Near this spot, just after the turn of the 19th century, a family of minor Parisian aristocrats named du Pont settled with the intention of constructing a gunpowder factory. Hounded from their homeland by the French Revolution, they had headed for the new United States, seeking just the right power source for their enterprise. They found it here. Before long, the Brandywine's water was turning machines that crushed, mixed, and processed the raw ingredients: sulfur from Sicily and saltpeter from India, blended with charcoal from the valley's own native willow trees.

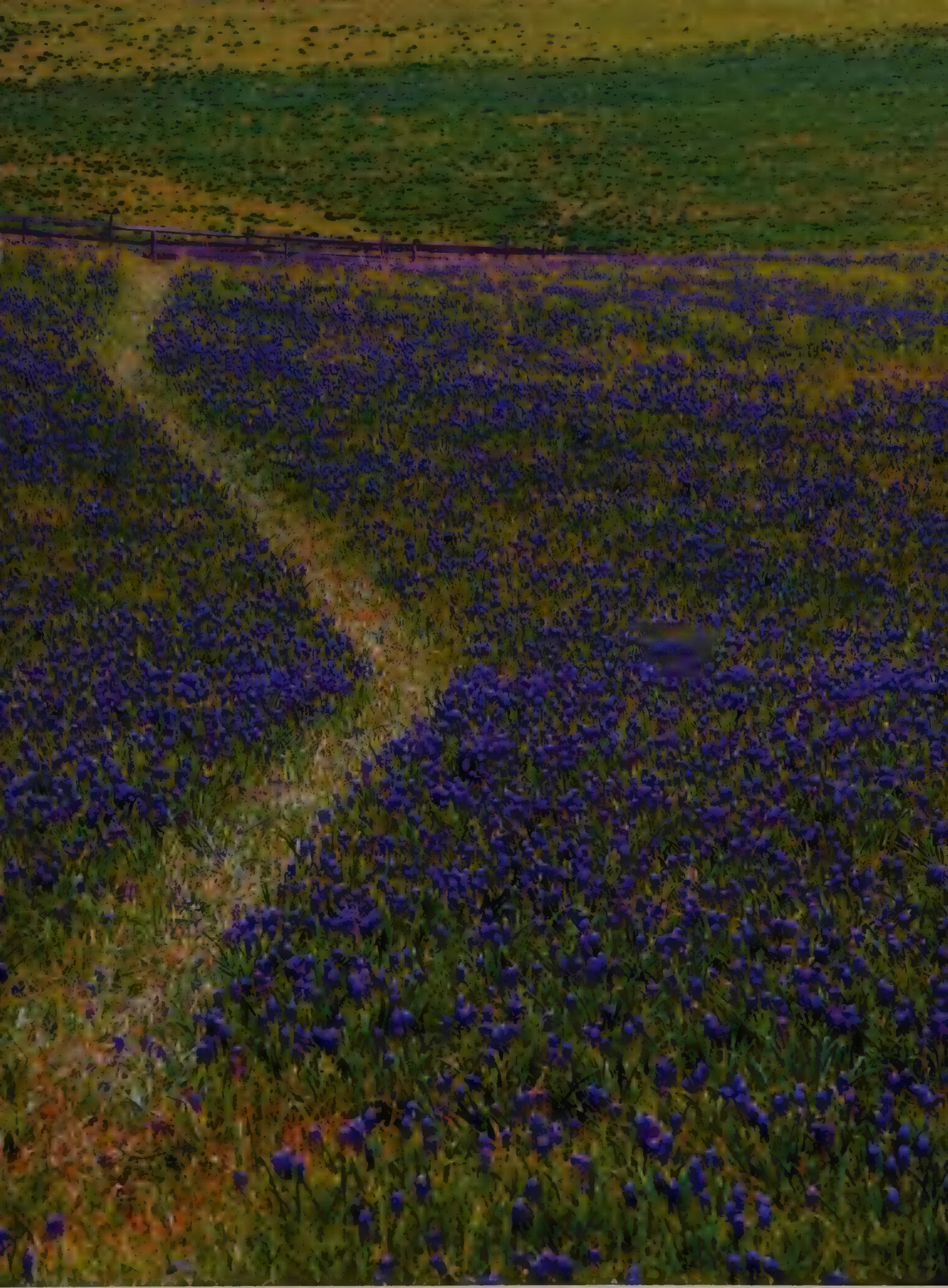
By 1860 the DuPont Company was the largest manufacturer of gunpowder in the nation and soon was one of the largest in the world. Its products—with brand names like Eagle Gun Powder, Diamond Grain, and Louisiana Rifle—blasted the way for the Erie Canal and the transcontinental railroads; opened veins of California gold and Nevada silver; cut terrible swaths of destruction through Confederate armies, Indian tribes, and buffalo herds.

A First for Delaware

The proposed national monument would feature historical sites dating from before the Revolutionary War in all three of Delaware's counties.


UNITED STATES
AREA ENLARGED
PENNSYLVANIA
Brandywine Cr.
Philadelphia
Delaware
NEW JERSEY
Wilmington
New Castle
NEW CASTLE
Dover
KENT
Delaware Bay
DELAWARE
Cape Henlopen
Lewes
SUSSEX
ATLANTIC OCEAN
MARYLAND
1 Woodlawn
2 Old Swedes Church
3 Fort Christina
4 Old Sheriff's House
5 Old New Castle Courthouse
6 Dover Green
7 John Dickinson Plantation
8 Ryves Holt House
0 mi 10
0 km 10
NGM MAPS

That gunpowder also touched off the explosive growth of one of America's great family fortunes. Soon the rapidly proliferating du Pont descendants filled the highlands along the Brandywine with their estates, each more magnificent than the last, crowding the river like châteaus along the Loire. Most still stand today, surveying the valley with lordly hauteur: great



A Pennsylvania field splashed with grape hyacinths was the site of heavy combat in 1777 during the Battle of Brandywine. British troops outflanked Washington's army, clearing a path for the redcoats to march on Philadelphia and take the city.

Inside the John Dickinson Plantation in Dover, Delaware, portraits of the patriot's parents oversee side-by-side rooms. Dickinson championed colonists' rights in the run-up to the Revolutionary War and later signed the Constitution.

stony piles crowned with turrets and cupolas, swaddled in topiary and wrought iron. Those that have not become museums remain, to a large extent, in the hands of du Pont descendants (who now number in the thousands). A visitor to the Brandywine often gets the sense that it is one of the few places in America to which the word "feudal" can be applied.

Yet the du Ponts were, in a sense, late arrivals. It wasn't a French aristocrat who launched the industrial revolution along the Brandywine, but rather a Delaware shoemaker's son named Oliver Evans, one of America's greatest unheralded inventors and the godfather of automated manufacturing. In the 1780s he created a new system of flour milling that, with an ingenious arrangement of water-driven wheels, gears, and shafts, almost removed human labor from the process of turning wheat into flour. Visiting millers were incredulous to see Evans's mill grinding busily away as if by magic, completely unattended, while the owner himself worked placidly in a nearby field. Soon Evans-style gristmills—for which the inventor received the third U.S. patent ever granted—were lining both banks of the Brandywine, and their basic principles were being adapted to manufacture paper, textiles, and other products. The Brandywine Valley was to automation what Silicon Valley would later be to microprocessing.

Now, after 200 years, the core of the proposed national monument is emerging from the legacy of those fortunes. At its center is a 1,100-acre tract of upland meadows and woods known as Woodlawn, preserved from development a century ago by a Quaker textile manufacturer and philanthropist. It is one of the last large undeveloped sites in an area increasingly hemmed in by the encroaching outskirts of Wilmington and Philadelphia. On summer afternoons the song of cicadas blends with the whoosh of traffic from a nearby road lined with fast-food restaurants and strip malls.

Still, within the valley's narrow enclave, time's passage often seems suspended. Colonial stone houses, neat and dignified, stand amid rolling cornfields. They look almost like natural outcroppings of rock, cut from the same stone—ash gray gneiss and granite, tinged here and there with rusty orange—as the Brandywine gorge itself. History and landscape blend.

It is this uncanny confluence that has powered another of the river's outsize contributions: the movement in American art often known as the Brandywine school of painting, over which the Wyeth family has held sway for more than a century. The clan's exuberant patriarch, N. C. Wyeth, came here as a 20-year-old art student in 1902 and eventually made it his home, entranced as he was by the peculiar eloquence of his surroundings. "The tawny hills all around us speak volumes," he wrote his parents back in Massachusetts.

In Wyeth's famous illustrations for the works of Robert Louis Stevenson and other authors, the Brandywine Valley's woods were transmuted into the forests of England, its meadows into the highland heaths of Scotland. Today a Continental Army greatcoat hangs from a peg in the painter's studio, alongside costumes from other eras that helped make historical ghosts visible.

N. C.'s equally famous son, Andrew, spent much of his long life in an ancient stone house on a corner of the Brandywine Battlefield. Here, in 1777, British troops under General William Howe trounced George Washington's army in one of the largest land battles of the Revolution. Andrew Wyeth's paintings—meticulous watercolors and temperas of time-weathered barns or the windburned faces of neighboring farmers—seem to hover in some indeterminate moment between the 18th century and the 20th.

Though it is often called the First State—a reference to its primacy in ratifying the U.S. Constitution—Delaware is the last one of all 50 states to have a unit of the National Park System established on its soil. The proposed First State National Historical Monument would attempt to make up for this by including not only the Woodlawn property but also a string of smaller historical sites throughout the state.

One of these, a 1740 plantation house that once belonged to the Revolutionary-era patriot John Dickinson, stands 50 miles south of the du Ponts' and Wyeths' domains, on a knoll overlooking flat marshes and misty fields. It feels far more distant. If the Brandywine Valley often seems tinged with New England hues, the middle and lower parts of the state resemble the tidewater South.

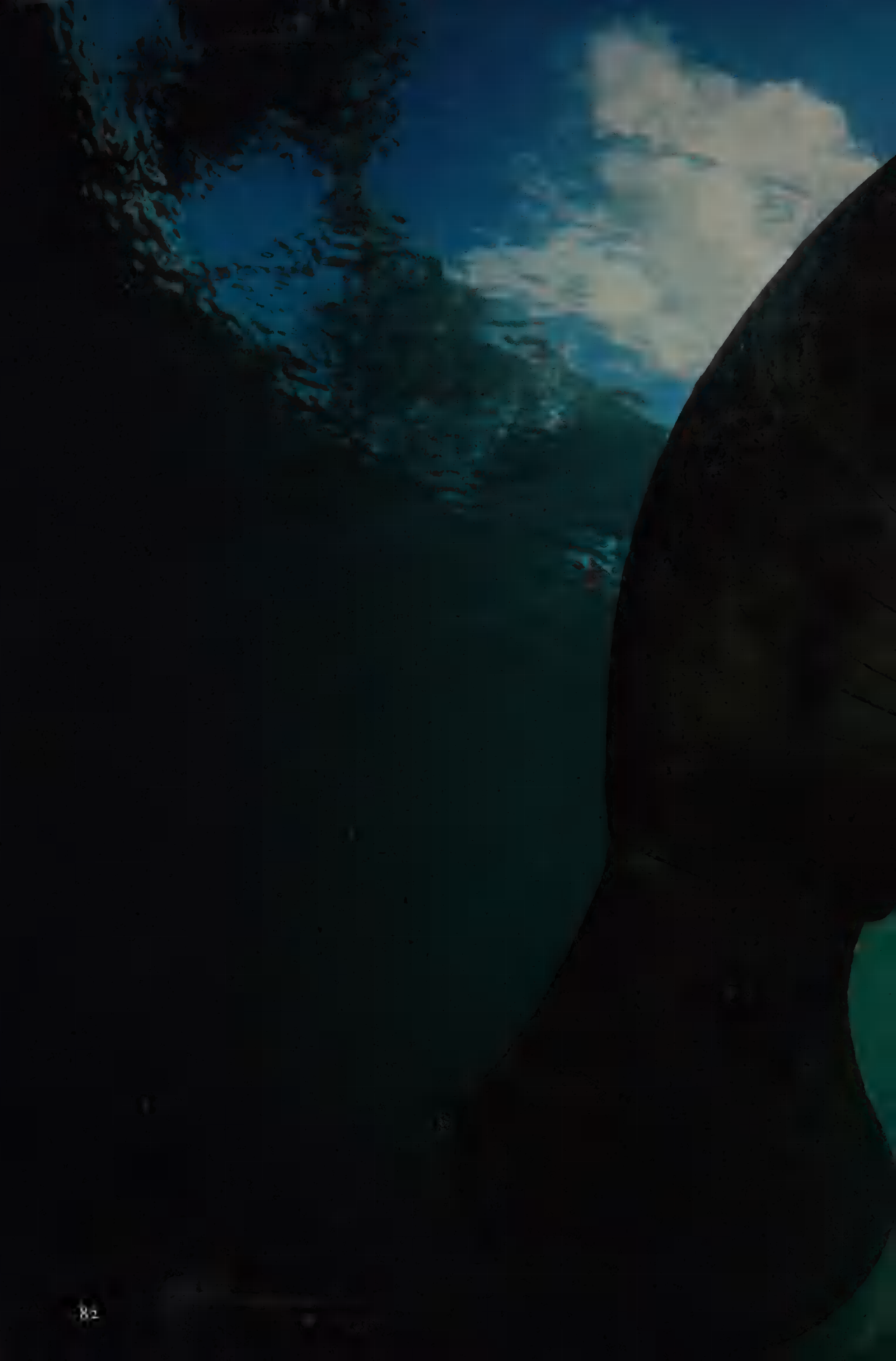
The Brandywine Valley was to automation what Silicon Valley would later be to microprocessing.

On Dickinson's plantation some five dozen slaves once harvested corn and wheat. Their master, one of the first and most eloquent advocates of American resistance to British tyranny, wrestled with the contradictions of espousing liberty while owning human beings as property. Unlike most of the new nation's founders, he moved to address this cruel paradox while the ink was practically still wet on the Declaration of Independence. In 1777 he drew up a deed of gradual manumission—and then, nine years later, freed all his remaining slaves immediately and unconditionally.

Among the other potential sites in the national monument is a 17th-century Swedish colonial church and fort, an early settler's house, and—perhaps most resonant of these—the Dover Green, a grassy quadrangle at the heart of Dover, Delaware's small capital. It was here that, in December 1787, delegates from across the state gathered to endorse the new federal Constitution recently signed in Philadelphia. They put their state the very first in line. There may be poetic symmetry if the National Park Service finally brings Delaware into its fold, this time as the last of all. ☐

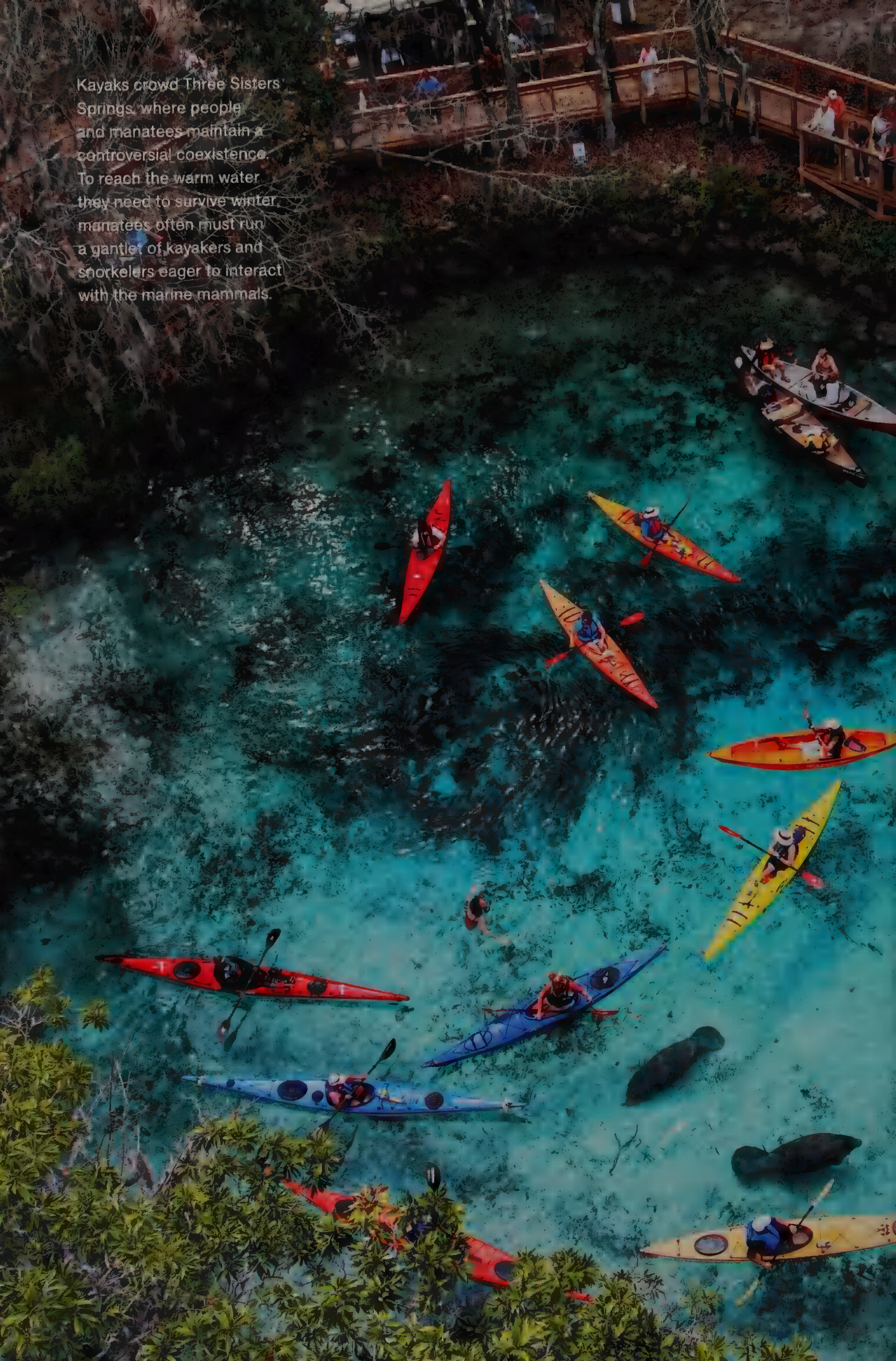
Oaks and maples shimmer with the season at Woodlawn, the 1,100-acre heart of Delaware's proposed national monument. Industrialist William Bancroft bought this land for a park, predicting in 1909, "It may take a hundred years to work out."

Painter Andrew Wyeth kept a secret studio a few miles from this Woodlawn farmhouse, creating works of art inspired by the surrounding landscape until his death in 2009. Some of his paintings evoke similar wintry scenes.



When push comes to shove

The Florida manatee *is thriving in Kings Bay, and so is tourism. Therein lies the problem.*



Kayaks crowd Three Sisters Springs, where people and manatees maintain a controversial coexistence. To reach the warm water they need to survive winter, manatees often must run a gantlet of kayakers and snorkelers eager to interact with the marine mammals.

By Mel White
Photographs by Paul Nicklen

The welcome sign on the outskirts of Crystal River isn't the kind you see every day: "Manatee Information: Tune to 1610 AM," it reads. Then, too, not many towns have a red-white-and-blue statue of an endangered marine mammal in front of City Hall.

Stop to ask where you can see these aquatic celebrities, and you learn that a couple dozen local dive shops offer snorkeling tours in Kings Bay. Or you can rent a kayak and paddle to one of the warm springs where manatees hang out in winter. Or if you want to watch from dry land, you can head over to the canal west of Three Sisters Springs.

At the canal it takes only a few minutes before the first manatees cruise below, pale ghosts in the jade green canal. They pass alone, or with a single calf, or occasionally in groups of three or four. There's a constant flow of people coming and going too.

"It's like a big rusty oilcan floating in the water," a man says.

"Why, they don't look like nothin' at all!" a woman exclaims in a Dixie drawl, and she has a point. The blobby shapes passing under the bridge will never win any wildlife beauty contests. The only color they show is the pink of propeller scars, parallel gashes like sidewinder rattlesnake tracks on their gray backs.

"There's no room for the manatees," says another man, noting the boat traffic sharing the narrow canal with the animals. "That's how it goes." He shakes his head ruefully. "Places get commercial, and people just don't care."

Oh no. No, sir. That's where you've got it wrong. People have very strong opinions about manatees in Kings Bay. See the signs around town, the ones that say, "Save Crystal River" and "Get U.S. Fish and Wildlife Service Off Our Back"? Around here, people care about manatees more than you can imagine.

Crystal River National Wildlife Refuge administers a substantial part of Kings Bay, a 600-acre lake that discharges into the Gulf of Mexico 65 miles north of Tampa. The town of Crystal River adjoins the refuge—embraces it, you might say, geographically, though not always figuratively. Indeed, there have been times when some residents have treated refuge manager Michael Lusk as the uniformed embodiment of evil.

On his arrival at Crystal River in 2009, Lusk walked straight into a critical mass of contention: government regulation versus personal freedom, public access versus private property, change versus tradition, idealism versus money. And though the local conflicts mirrored national issues, their cause was unique, and uniquely ironic: the manatee, a creature as devoid of aggression as a teddy bear.

Weighing up to 1,200 pounds or more, the West Indian manatee looks something like a chubby dolphin or small whale, though it's related to neither. (In fact, manatees share a common ancestor with elephants.) Manatees lack the blubber layer

Manatees swim close to the water's surface because they are air-breathing mammals. They use their stiff facial bristles to guide food into their mouths.

that allows whales to tolerate cold; in water below 68°F, they begin to weaken and die. The subspecies found in the United States is the Florida manatee, which disperses into coastal areas of the Atlantic Ocean and Gulf of Mexico; in winter, when sea temperatures drop, they congregate inland at natural springs and other sources of warmth, including power plant discharge pipes.

At Kings Bay manatees have a near-perfect winter refuge. Dozens of springs scattered around the bay pump out fresh water at a constant 72°F year-round. The Kings Bay area is so suited to manatees that the wintering population has grown from about 30 in the 1960s to more than 600 today, mirroring the species' increase to about 5,000 throughout Florida. On any day from November through March, Crystal River residents can quite literally walk out their doors and see dozens of manatees swimming, loafing, and sleeping in city canals like lazy dogs curled up on the lawn.

"This is basically an urbanized wildlife species that lives in our backyard, 50 feet from where we sleep," says USGS biologist Robert Bonde, who's

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Mel White reported on birds of paradise in the December issue. Paul Nicklen specializes in underwater photography, often in polar regions.

studied Florida manatees for more than 35 years. "They're as wild as free-ranging elephants, yet here they are."

This cozy proximity has made Crystal River the de facto manatee capital of the United States, a title enhanced by yet another unique circumstance. Nowhere else are people encouraged to enter the water and swim with manatees: approaching them, interacting, and even touching them. Such intimacy with an endangered and federally protected wild animal would never be permitted if it were proposed today, but the activity has long been a popular tourist draw at Crystal River, predating the Endangered Species Act of 1973 and the establishment of the refuge a decade later.

The "swim-with" program is just one of several issues that have conservationists, boaters, landowners, politicians, and tour operators facing off over the future of Kings Bay. And the U.S. Fish and Wildlife Service, which oversees the national wildlife refuge system and manages the manatee population, stands in the middle like the sheriff in a town of feuding clans, trying to keep the peace.

"There are plenty of wildlife issues, like wolves out west, that are just as controversial," Michael Lusk says, "but the emotion around these animals is amazing."

ON A TYPICAL WINTER weekend Three Sisters Springs doesn't look much like a wildlife refuge. Party barges, runabouts, kayaks, and swimmers crowd the narrow adjoining canal. Add some kegs of beer and blaring hip-hop, and it could be a fraternity party.

These folks are mostly as respectful and subdued as people can be when one-ton animals regularly swim past. The tour boat captains have lectured their customers: Don't disturb resting manatees; don't block them when they leave the roped-off area where people are forbidden. But kids squeal, and adults… Well, they sometimes do more than squeal.

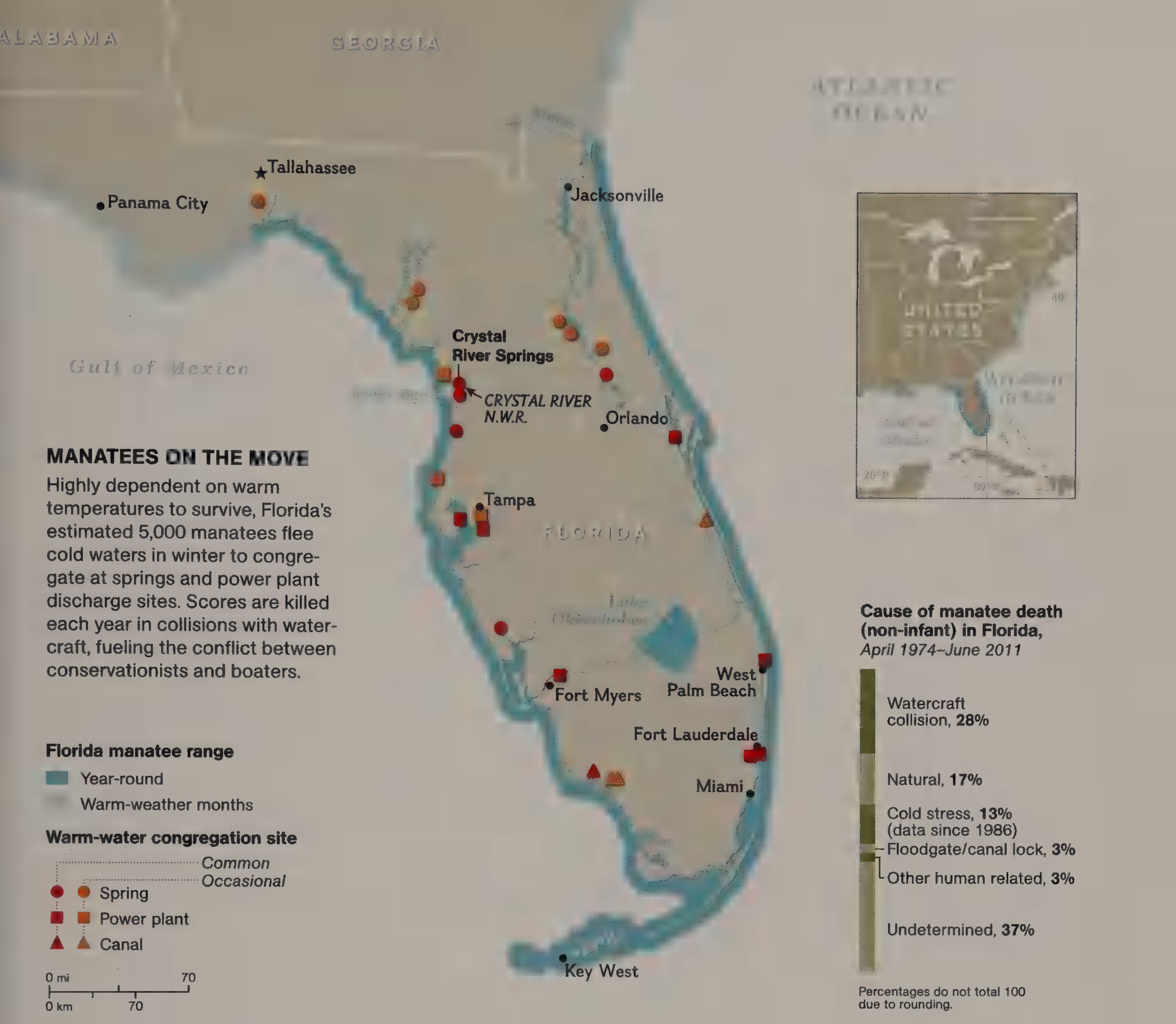
Mike Birns leads tours to Three Sisters and other manatee-viewing spots around Kings Bay. "This happens on a regular basis on my trips," he says. "Someone comes back to the boat, and she's just bawling: 'Oh it was great! It came right up to my face!' She's so overcome by emotion she can't wait to go out and save the manatees. I'll tell you, for a lot of people, it really is a spiritual experience."

Manatee advocates agree that many of the more than 150,000 people who come to Crystal River each year to swim with (or kayak above) the manatees leave with a heightened appreciation for the animals—though that fact doesn't excuse disruptive behavior. In 2006 local activist Tracy Colson began making videos of manatee abuse, including people riding manatees and guides taking babies from mothers to pass around to tourists. Her YouTube posts shocked manatee lovers and helped bring stricter guidelines for interaction.

"Someone comes back to the boat just bawling: 'It came right up to my face!' She's so overcome by emotion she can't wait to go out and save the manatees." *—Mike Birns, Kings Bay tour operator*

Patrick Rose, an aquatic biologist and executive director of the influential Save the Manatee Club, somewhat grudgingly supports the swim-with program, though he's determined to see changes made. "Most manatees don't want to have much of anything to do with people," he says. "They seek out quiet places to rest, especially on cold winter days and nights when their most critical priority is to stay warm."

Rose believes the situation at Crystal River constitutes harassment of manatees, "in direct violation of both the Marine Mammal Protection Act and the Endangered Species Act." He advocates stricter rules requiring swimmers to stop a body length away from manatees, which would then be free to interact or not, at their


ALABAMA
GEORGIA
ATLANTIC OCEAN
Tallahassee
Panama City
Jacksonville
Gulf of Mexico
Crystal River Springs
CRYSTAL RIVER N.W.R.
Orlando
Tampa
FLORIDA
Lake Okeechobee
West Palm Beach
Fort Myers
Fort Lauderdale
Miami
Key West
UNITED STATES
40°
20°N
80°W
Florida manatee range
Year-round
Warm-weather months
Warm-water congregation site
Common
Occasional
Spring
Power plant
Canal
0 mi 70
0 km 70
Watercraft collision, 28%
Natural, 17%
Cold stress, 13% (data since 1986)
Floodgate/canal lock, 3%
Other human related, 3%
Undetermined, 37%

MANATEES ON THE MOVE

Highly dependent on warm temperatures to survive, Florida's estimated 5,000 manatees flee cold waters in winter to congregate at springs and power plant discharge sites. Scores are killed each year in collisions with watercraft, fueling the conflict between conservationists and boaters.

Cause of manatee death (non-infant) in Florida, *April 1974–June 2011*

Percentages do not total 100 due to rounding.

choosing. "The majority of the dive shops are trying to do a good job," Rose says. "If they want to be responsible and protect the privilege they have here, which is so unique, then fine. If not, the swim-with program should go."

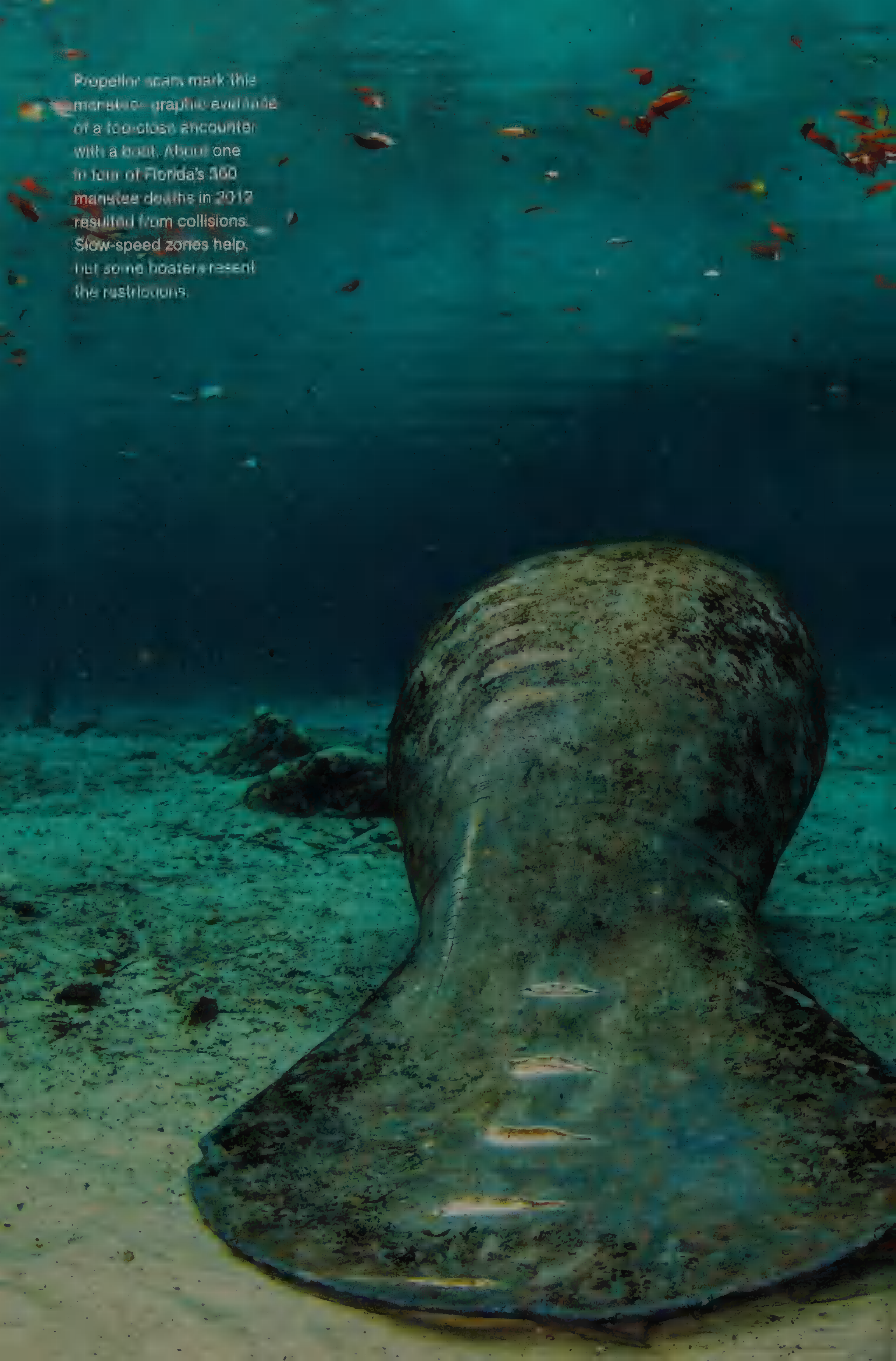
Tracy Colson agrees. "There should be no rubbing or touching," she says. "That's what dogs are for. Manatees are wild animals. Let them be wild."

The issue reaches deeply into pocketbooks. Estimates of the local economic impact of manatee-related tourism range from $20 million to $30 million a year. Some dive-shop owners claim they'd lose substantial business if customers weren't able to go home and tell friends, "I touched a manatee." Aware that their livelihood could be in jeopardy, 16 tour operators in 2011 formed the Manatee EcoTourism Association (META), working with the national wildlife refuge and the Save the Manatee Club to find a balance between access and protection. With Mike Birns as president, META has voluntarily adopted rules on human-manatee interaction that are sometimes even stricter than required by federal law.

For all the contention around swimming with manatees, it's not the issue that's caused the greatest controversy in Crystal River. The acrimony, accusations, and insults that have split the community, inspired full-page attack ads in newspapers, and poisoned the atmosphere at public meetings stem in large part from where, and how fast, people are allowed to drive their boats.

As air-breathing mammals, manatees spend much of their time near the surface, where they're

JEROME N. COOKSON, NGM STAFF; LOU CROSS; TANYA BUCKINGHAM
SOURCES: FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION; USGS



Propeller scars mark this manatee—graphic evidence of a too-close encounter with a boat. About one in four of Florida's 300 manatee deaths in 2012 resulted from collisions. Slow-speed zones help, but some boaters resent the restrictions.

vulnerable to moving boats. With more manatees living in Kings Bay year-round, the U.S. Fish and Wildlife Service in 2012 tightened restrictions on the designated high-speed sports zone, cutting its size and lowering the speed limit from 35 miles an hour to 25 in summer. For residents already resentful of limits on the way they can use the bay in their backyards, the regulations represented an unacceptable infringement of their freedom by a too-powerful federal bureaucracy.

Some of those in the anti-regulatory Save Crystal River group believe the regulations are part of a wider plan by conservationists, who see the expanding Florida manatee population as a chance to establish more refuges and further restrict not just boating but economic development and private-property rights. "The big issue is making the entire bay a refuge," resident Lisa Moore says. "If environmentalists win here, they've got it made. It's all downhill from here."

A manatee turns toward you, at once ponderous and graceful, and approaches, stopping when its face is just inches from your mask. What ensues, you tell yourself, is mutual contemplation.

The notion that Crystal River residents are being punished for their successful stewardship of manatees has fueled residents' anger; local T-shirts depict the U.S. Fish and Wildlife Service as a giant gorilla standing on City Hall.

"I don't think any of us would disagree that manatees have done very well," Michael Lusk says. "But that's a testament to the fact that they have been protected. Saying they don't need any more protection is like saying, Hey, our city is growing, so we don't need any more traffic regulations, and we don't need any more health codes."

Pat Rose says Crystal River's anti-refuge contingent—as well as boating interests and developers who continually work to weaken manatee protection laws throughout Florida—"have the money to fight for what they believe in, and more power to them. But I don't think that should be confused with facts, or with the law."

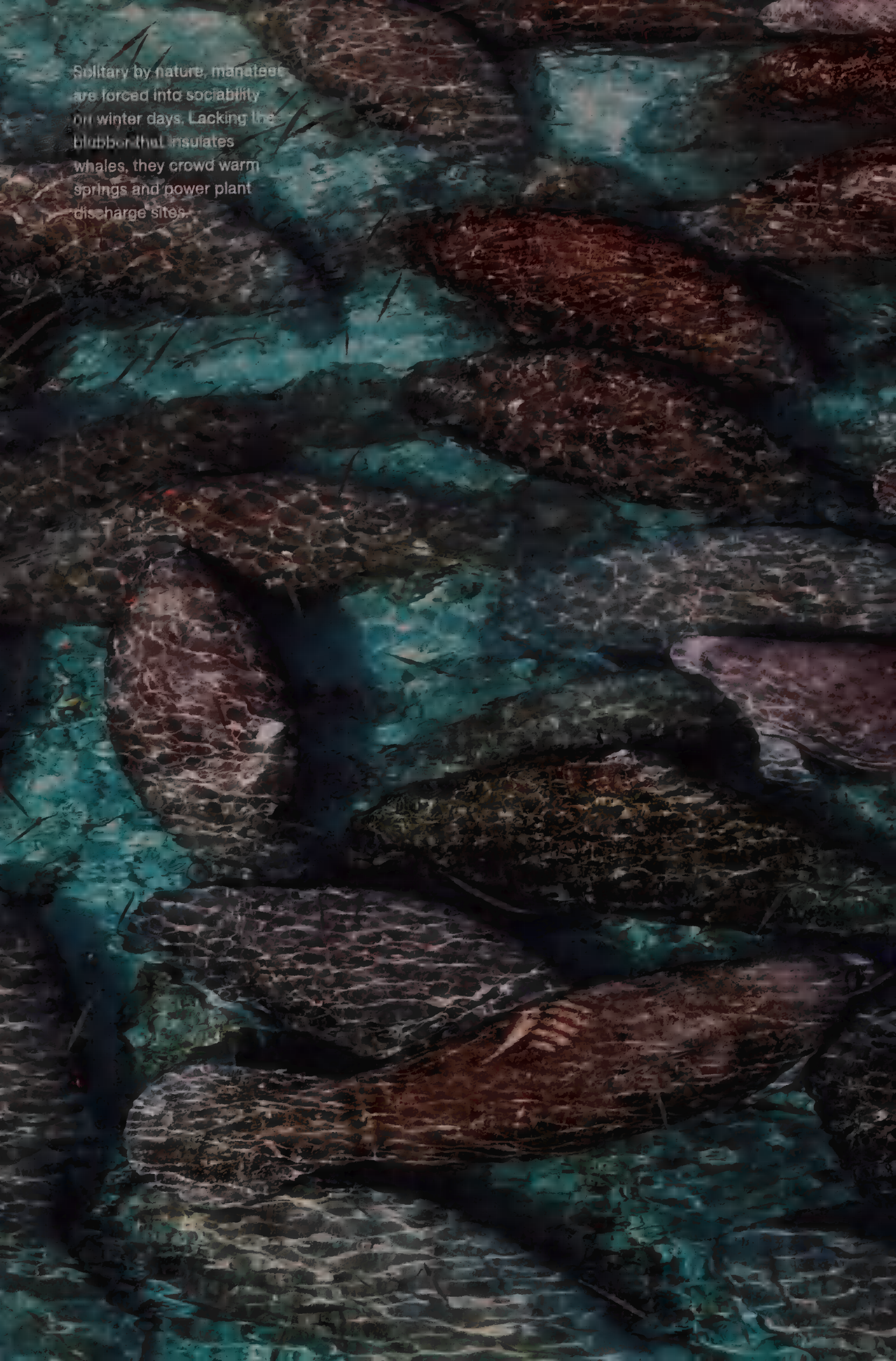
Yet another contentious issue looms in the not too distant future for Crystal River. Though tour boats take snorkelers and divers to several locations around Kings Bay, the narrow canal alongside Three Sisters Springs is by far the most popular. At times more than 200 manatees crowd into the area trying to rest and stay warm, while dozens of kayaks and scores of swimmers surround them and 20 or more tour boats lie anchored in the canal.

"What I hear from all the different user groups—the Save the Manatee Club, the city council, neighbors, kayakers, snorkelers—is that we need to manage the access into Three Sisters Springs when it's full of manatees," Lusk says. "Because it becomes an unpleasant experience not only for manatees but for people too."

That's easier said than done, though. Legal issues regarding waterway access and questions regarding the fair allocation of visitation rights complicate matters, and some dive shops and other local businesses would surely protest loudly at anything that might limit tourist numbers. As if a quota system weren't controversial enough, Pat Rose of the Save the Manatee Club advocates making Three Sisters a true sanctuary for manatees, keeping snorkelers and kayakers out of the water entirely and allowing observation only from a boardwalk around the springs. If that proposal ever comes to the table, it might make the fight over Kings Bay speed limits seem tame.

In the meantime travel magazines and television shows continue to publicize the chance to swim with manatees at Kings Bay, and Crystal River's appearance in the book *1,000 Places to See Before You Die* sparks people's imagination and desire for the once-in-a-lifetime experience of communing with these creatures. "There's no other place like Kings Bay," Michael Lusk says. "And it is precisely that uniqueness that will lead to escalating conflicts as more people flock here.

Crystal River Wildlife Refuge is the only place in the country where swimmers are allowed to touch manatees (above); some conservationists consider the practice harassment and want it banned. Scientists and volunteers capture manatees (below) to gather statistics on their age, size, and physical condition.



Solitary by nature, manatees are forced into sociability on winter days. Lacking the blubber that insulates whales, they crowd warm springs and power plant discharge sites.

"I'd like to find that place where we can allow people to interact with manatees and have that powerful experience, but manage it so that manatees are protected and safe. And I think we can find that."

Mike Birns has heard angry words at public meetings but has also seen opposing sides come together at times to compromise. "What's funny," he says, "is that the manatees have made us examine the very nature of how we govern ourselves."

AND SO YOU TOO shimmy into a wet suit and put on a mask and slip into the canal at Three Sisters Springs. As you lower your head, water muffles the sound of people talking and laughing. You paddle near the roped-off sanctuary and stop, watching dozens of big gray shapes resting near the bottom, soaking in the springwater surging from the Earth, warming themselves before they venture back out into the bay to feed.

A manatee turns toward you, at once ponderous and graceful, and approaches, stopping when its face is just inches from your mask. What ensues, you tell yourself, is mutual contemplation.

Is a manatee ugly? Pretty is as pretty does, the saying goes, and a manatee does what it does very well. Its big, dense bones make it buoyancy neutral in the water; evolution didn't consider that those bones would make it more likely to die from serious boat strikes. That flat, wrinkled face is as sensitive and muscular as a human tongue, perfectly adapted to allow a manatee to feed on aquatic grasses. Those strange hairs all over its face? They're vibrissae, like the ones cats and dogs have, connected to sensors that relay the slightest tactile impulse to the brain. Cats and dogs have about 50 vibrissae on their faces; a manatee has 600.

It's not the manatee's fault that it evolved in an environment with abundant food and no predators, so that it became unwary and vulnerable, so that its survival depends on our regard for it, our willingness to share this crowded planet.

Contemplation time is over. The manatee swims past you, and you turn to watch it fade slowly from sight. Down here it's the manatees' world, and you're just visiting. ☐

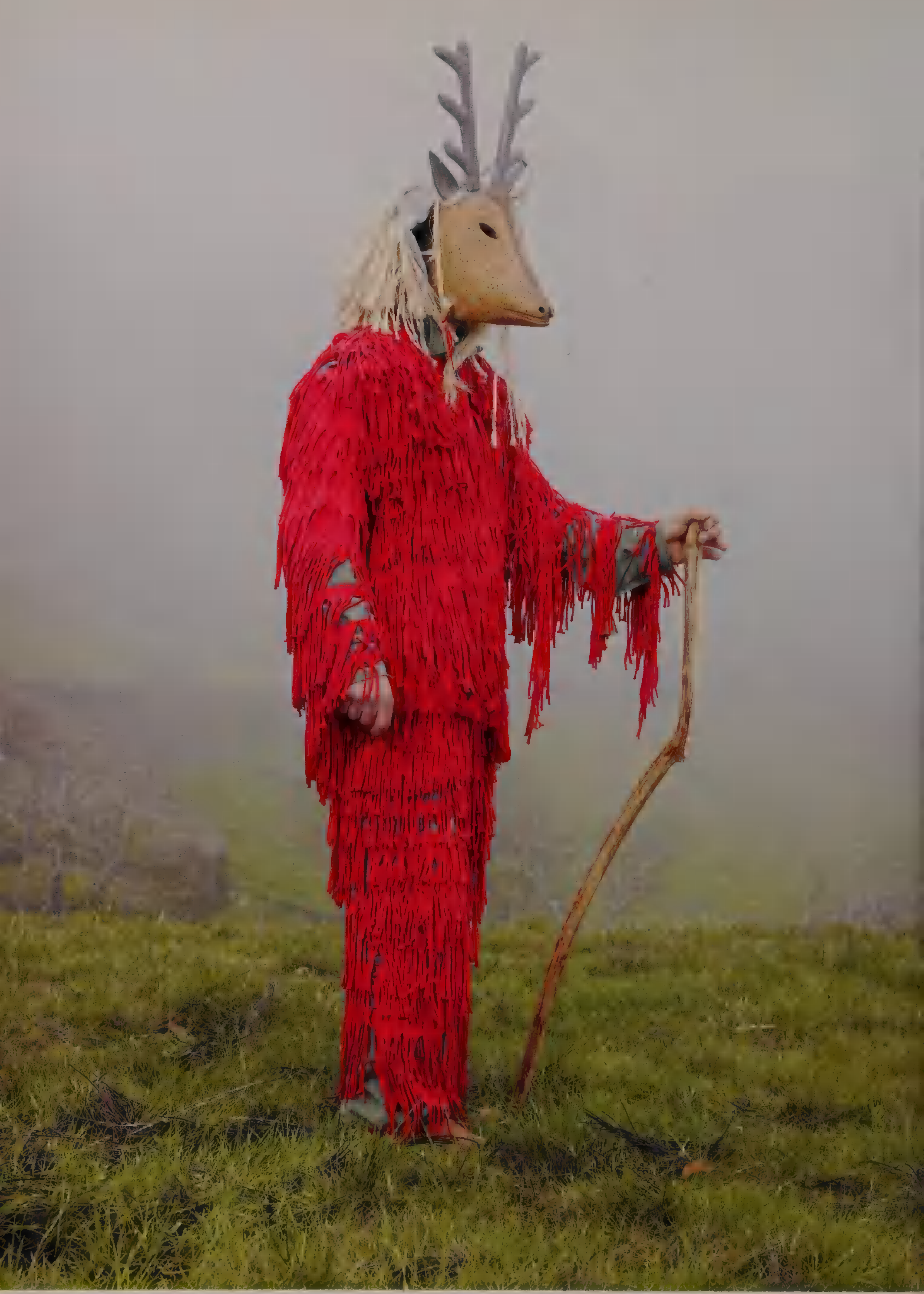
Young manatees nurse from teats behind the mother's flippers during a period of intense maternal care that may last two years. Constantly swimming beside their mothers, calves learn how to find food and sanctuary.

Europe's Wild Men

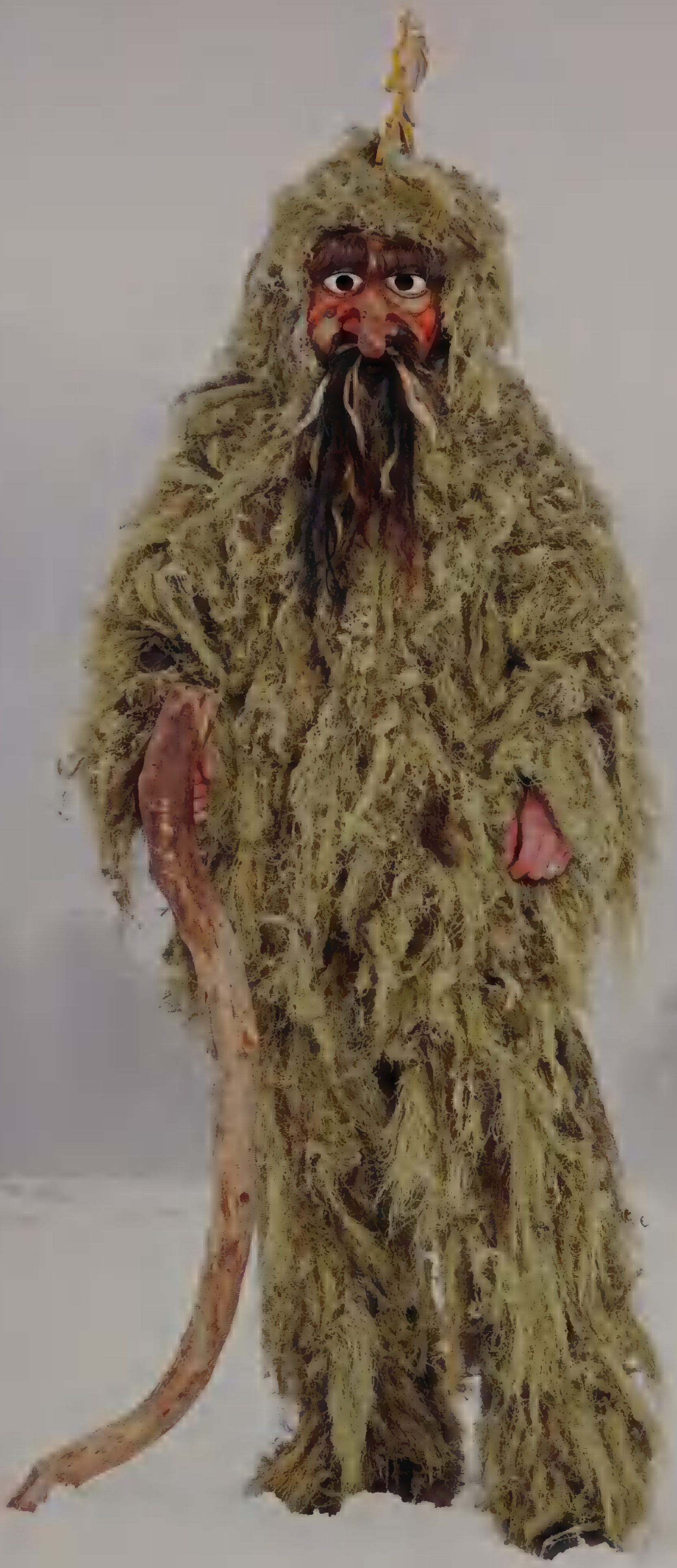
They become bears, stags, and devils. They evoke death but bestow fertile life. They live in the modern era, but they summon old traditions.

Photographs by Charles Fréger

FRANCE Spring festivals in the Pyrenees feature local men playing the role of bears awakening from hibernation.



PORTUGAL During Carnival in Lazarim characters called *caretos* parade through the village in hand-carved masks to a bonfire where effigies known as the *comadre* and *compadre* are burned.



AUSTRIA Every five years the men of Telfs collect lichen to create Wilder Mann, or Wild Man, costumes for the town's Carnival festival. Tradition dictates that they nibble on a piece of this lichen before the festivities.

CZECH REPUBLIC When jolly St. Nicholas visits the villages of Vysočina, he is joined by someone dressed as Smrt, or Death, whose scythe catches sinners.

A primal heart still beats in Europe. Deep beneath the gloss of cell phone sophistication lie rituals that hark back to harvests and solstices and fear of the winter dark. Monsters loom in this shadowy heart, but so does the promise of spring's rebirth and fertile crops and women cradling newborn babes. It turns out that Europe—at least pockets of it—has not lost its connection to nature's rhythms.

That connection is rekindled during festivals that occur across the continent from the beginning of December until Easter. The celebrations correspond to Christian holidays, but the rituals themselves often predate Christianity. The roots are difficult to trace. Men—and until recently, it has almost always been men—don costumes that hide their faces and conceal their true forms. Then they take to the streets, where their disguises allow them to cross the line between human and animal, real and spiritual, civilization and wilderness, death and rebirth. A man "assumes a dual personality," says António Carneiro, who dresses as a devilish *careto* for Carnival in Podence, Portugal. "He becomes something mysterious."

Photographer Charles Fréger set out to capture what he calls "tribal Europe" over two winters of travel through 19 countries. The forms of the costumes that he chronicled vary between regions and even between villages. In Corlata, Romania, men dress as stags reenacting a hunt with

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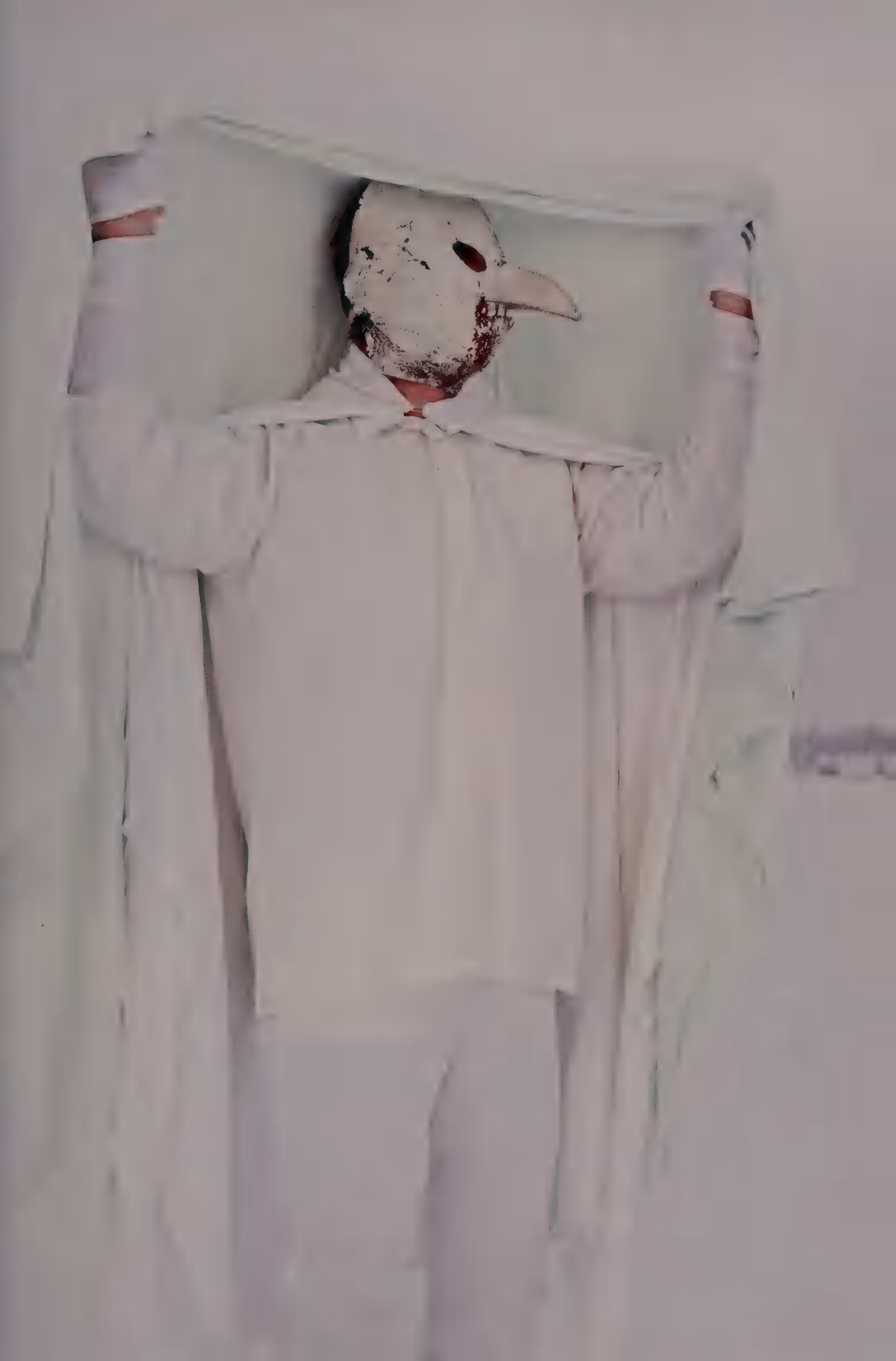
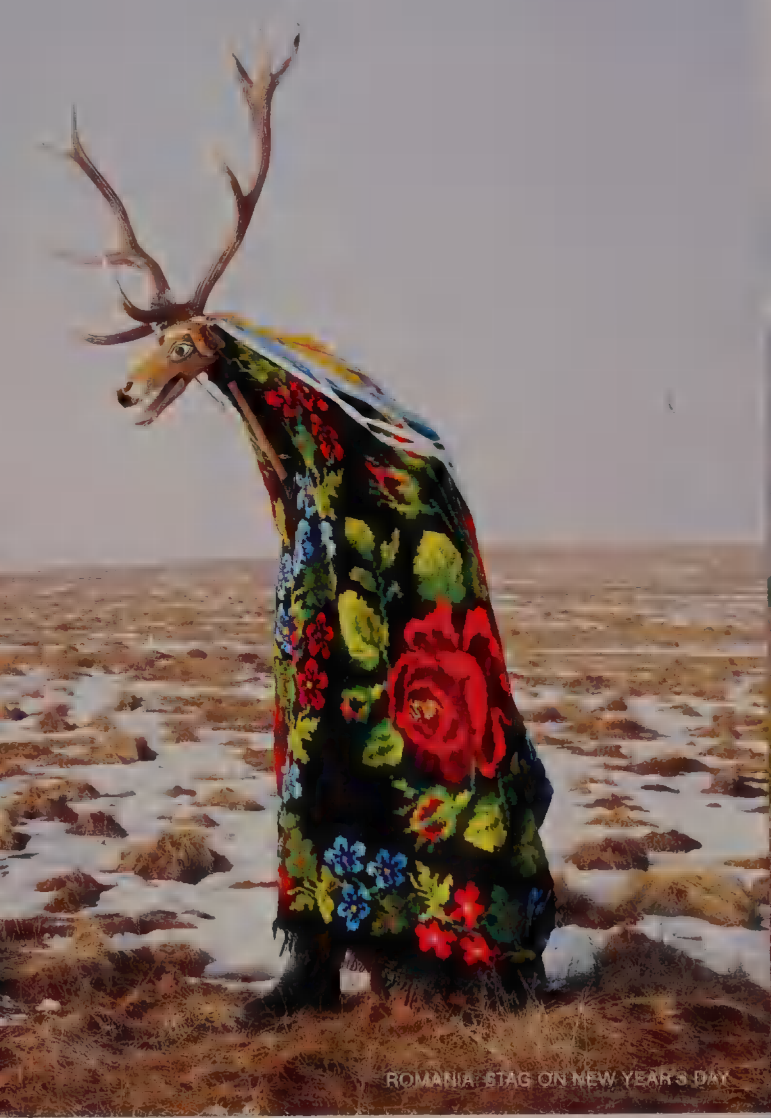
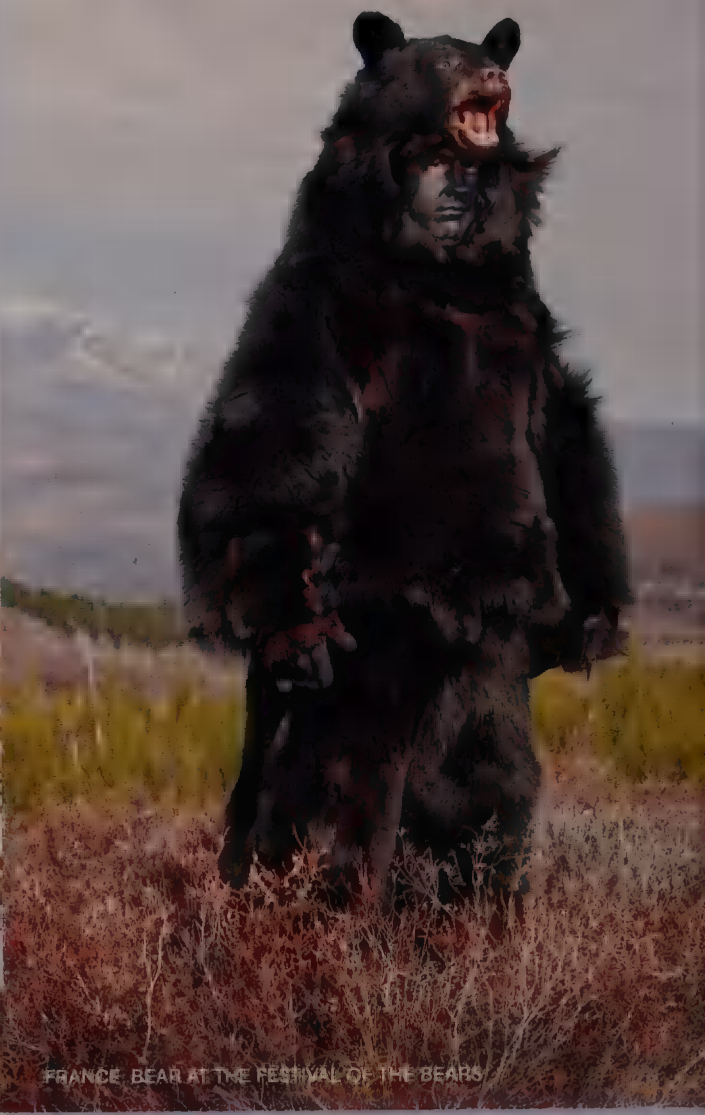
Charles Fréger is a fine art photographer based in Rouen, France. His latest book, Wilder Mann: The Image of the Savage, *was published in 2012.*

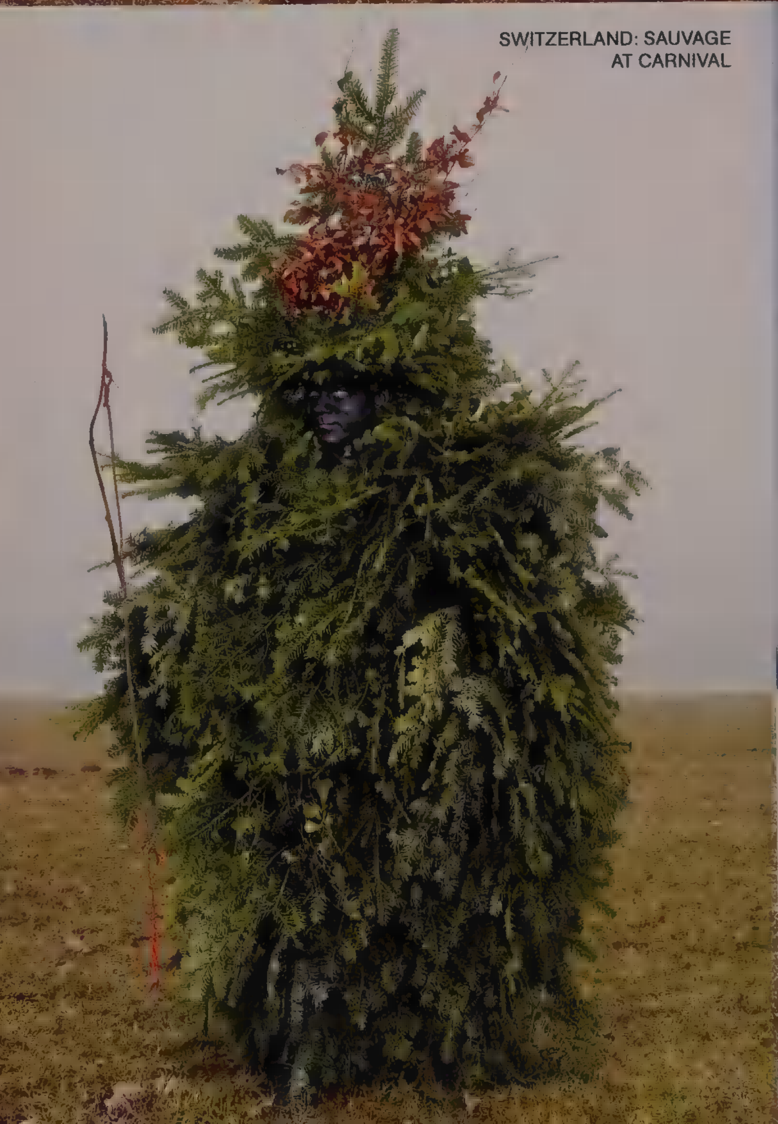




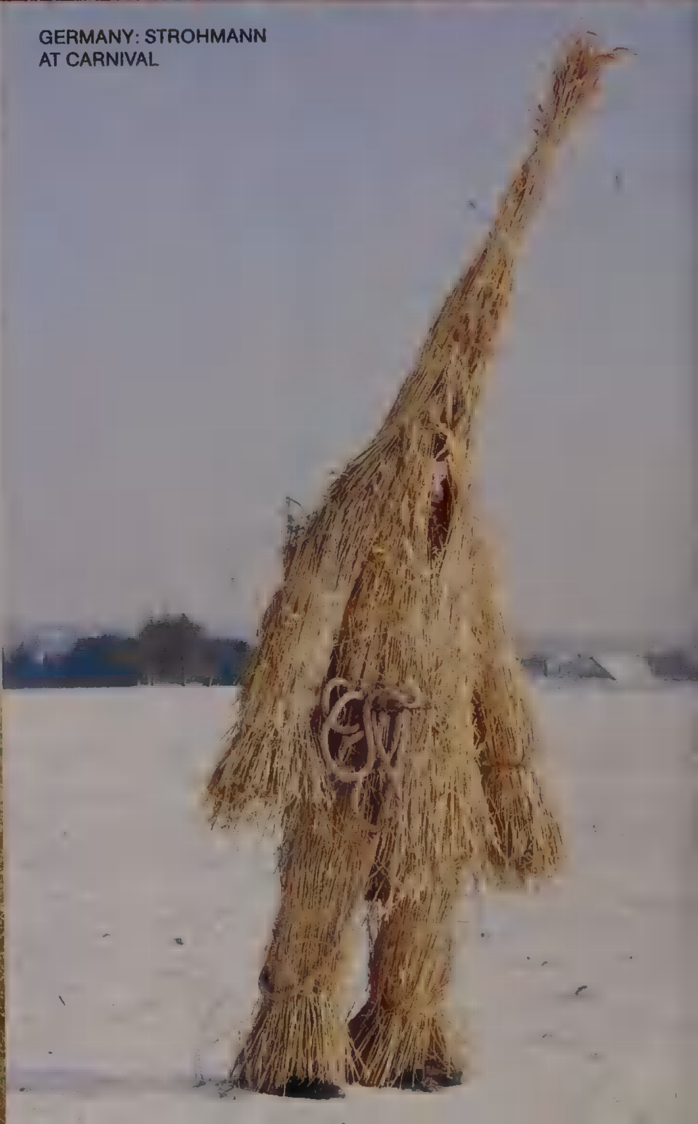
ROMANIA: STAG ON NEW YEAR's DAY



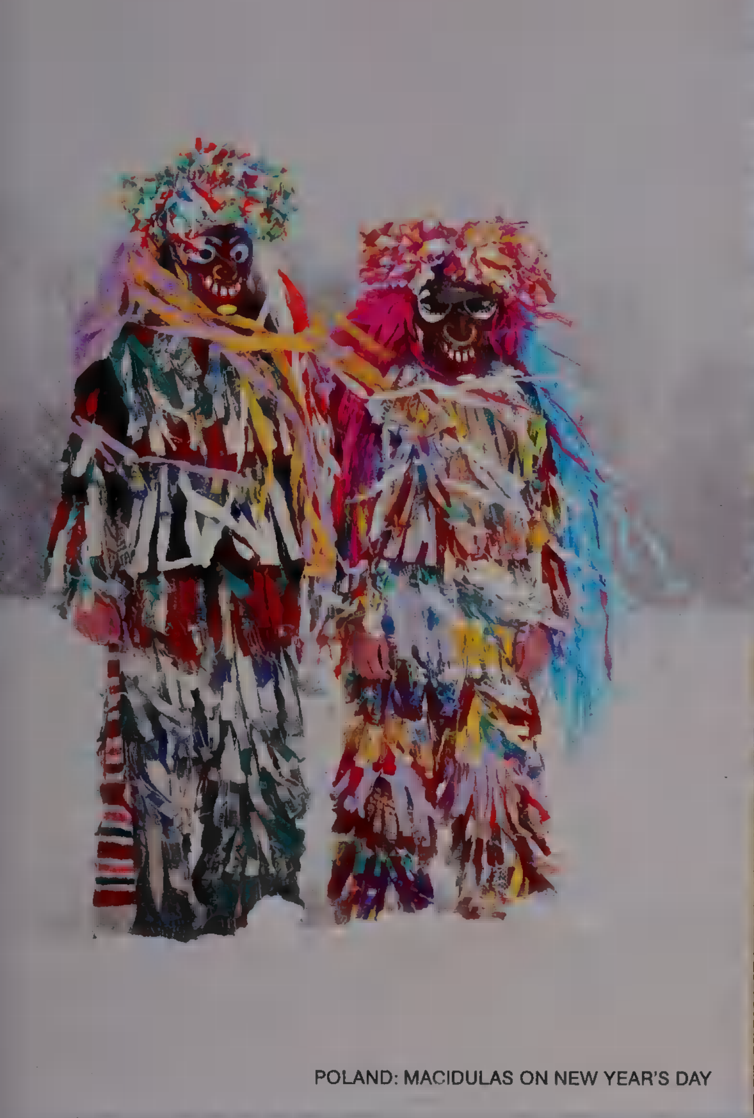
FRANCE: BEAR AT THE FESTIVAL OF THE BEARS



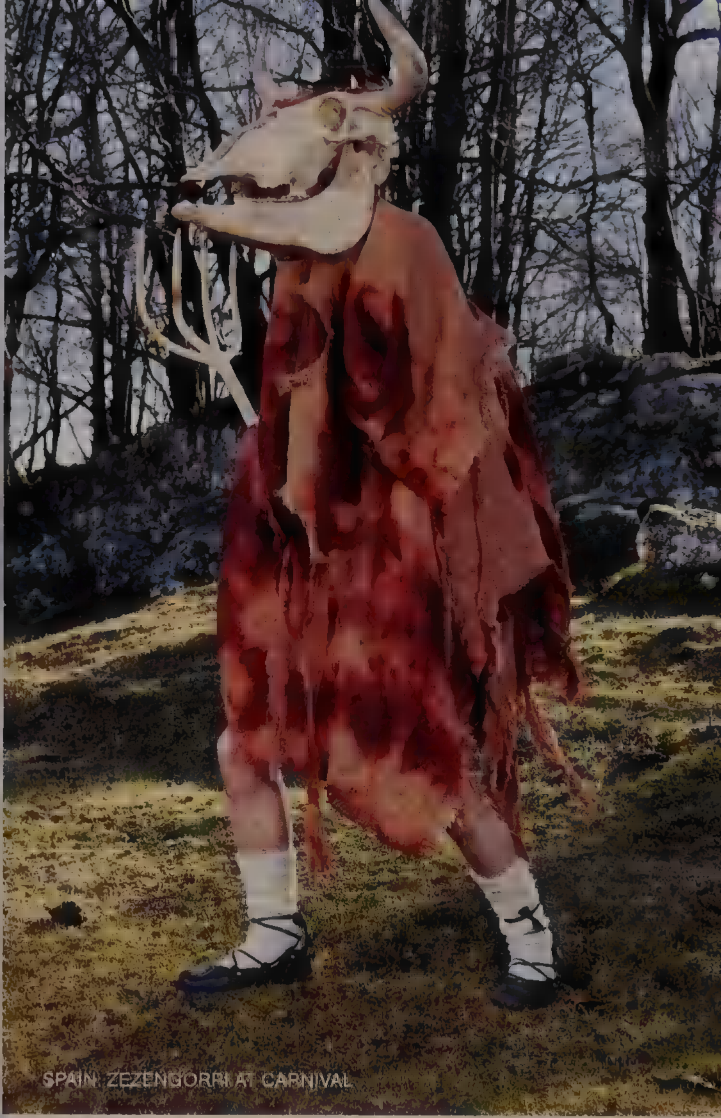
SWITZERLAND: SAUVAGE AT CARNIVAL



GERMANY: STROHMANN AT CARNIVAL

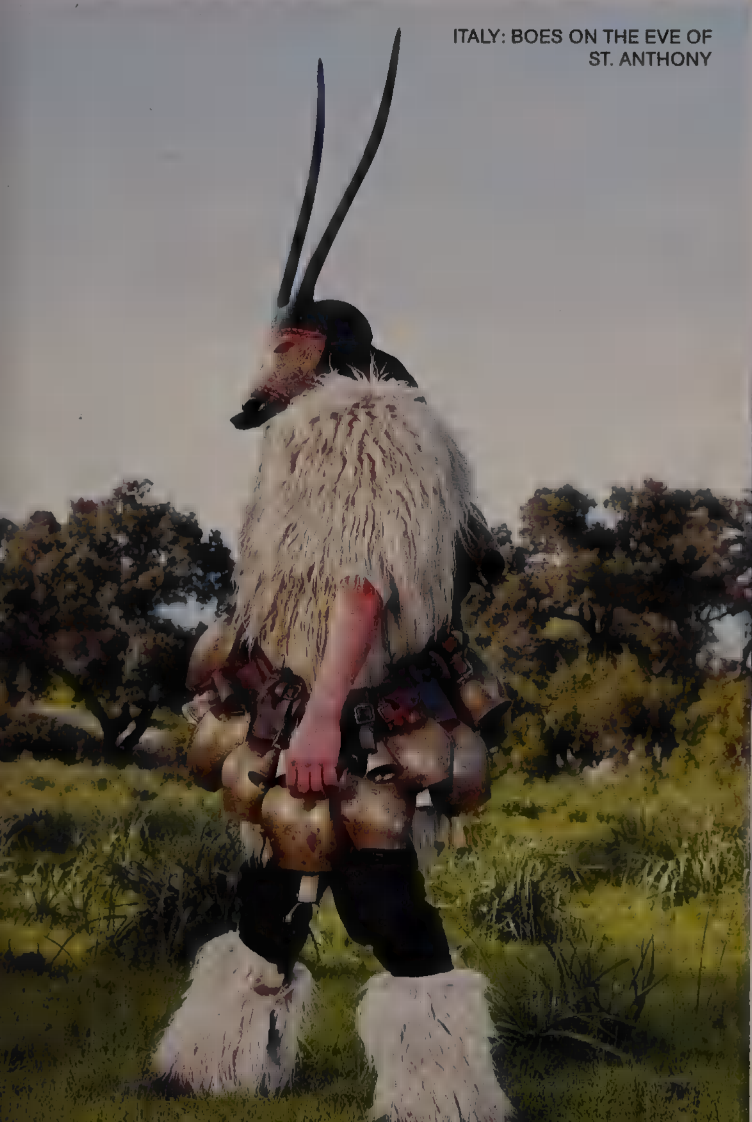


POLAND: MACIDULAS ON NEW YEAR'S DAY

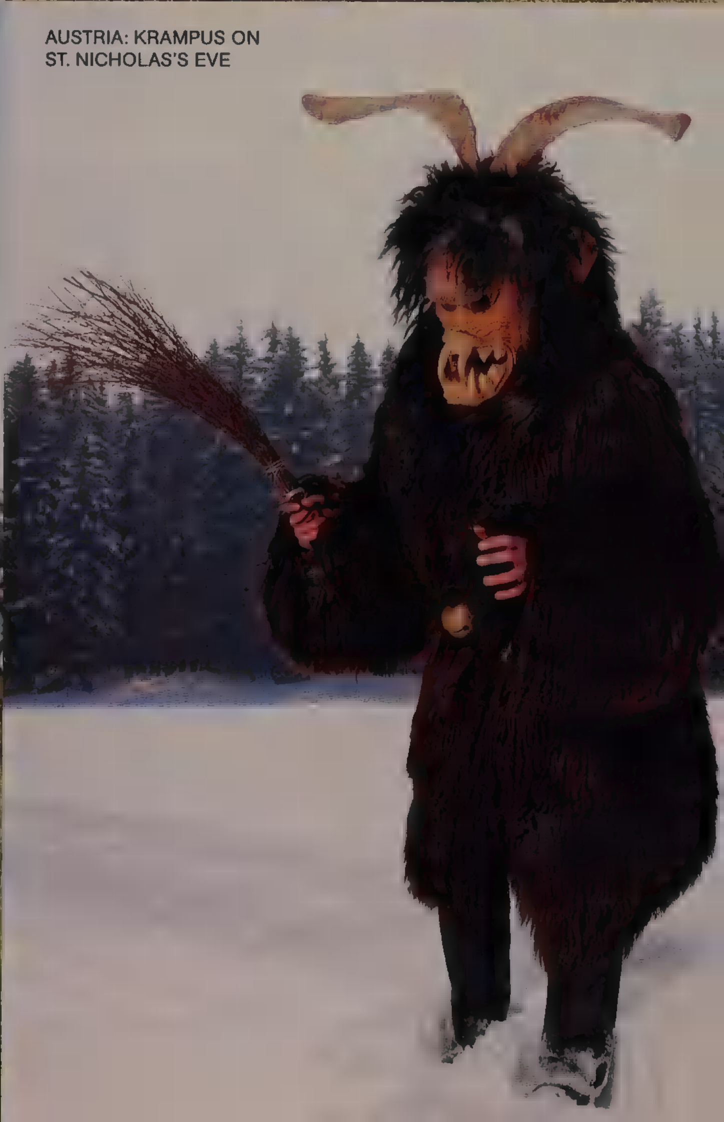


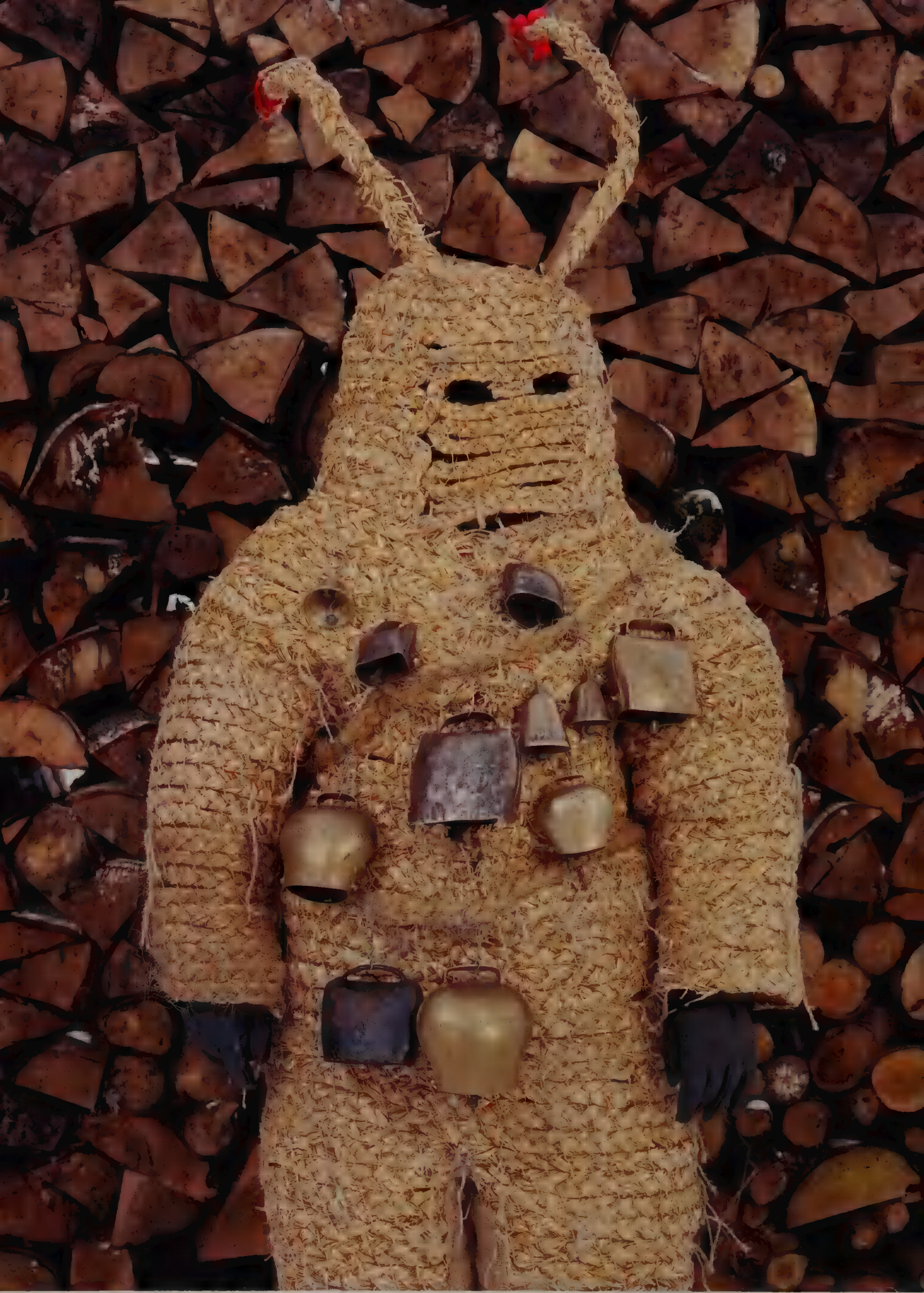
SPAIN: ZEZENGORRI AT CARNIVAL

ITALY: BOES ON THE EVE OF ST. ANTHONY

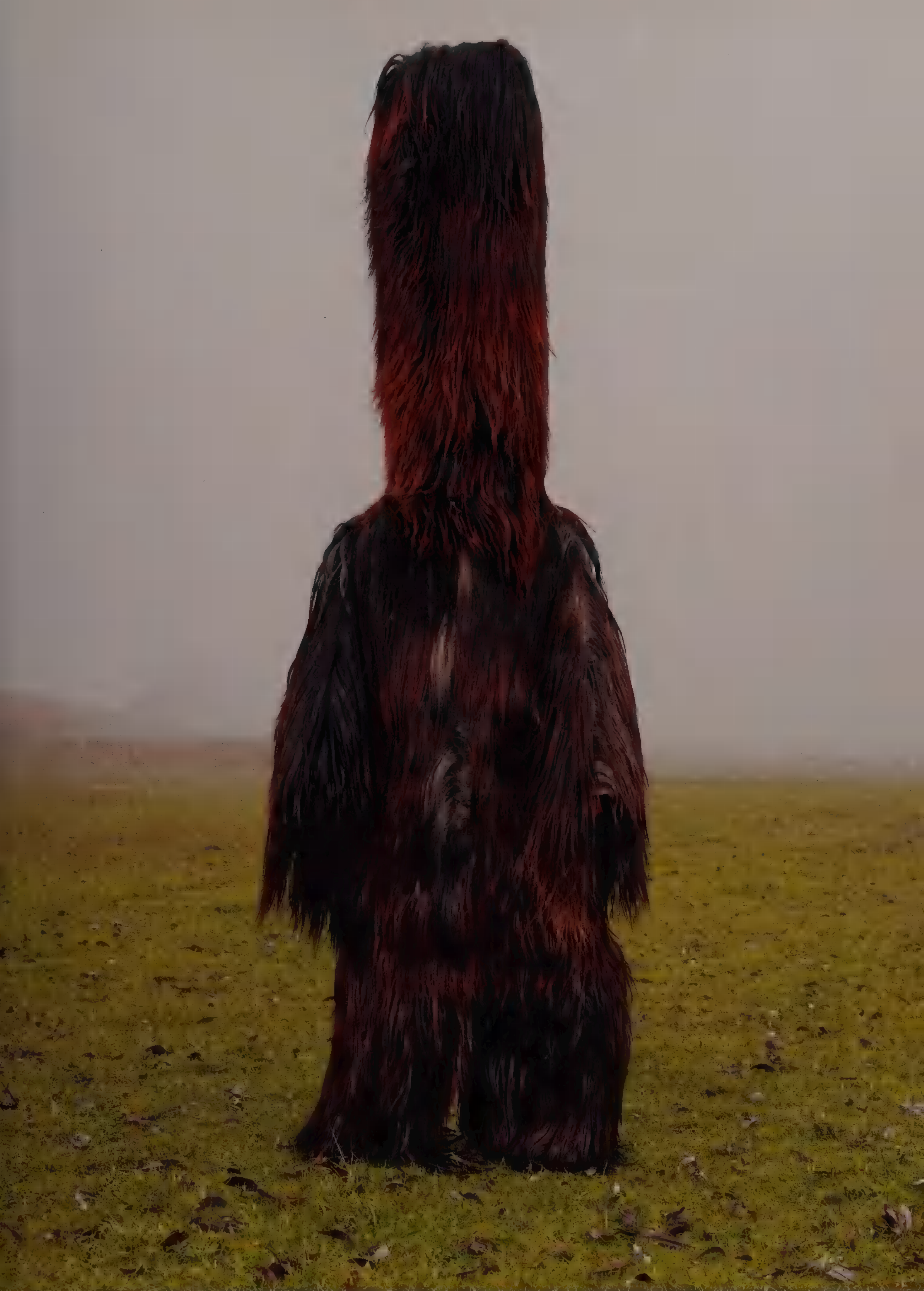


AUSTRIA: KRAMPUS ON ST. NICHOLAS'S EVE





GERMANY On Christmas Eve Pelzmärtle appears in the village of Bad Herrenalb with the Christkind (Baby Jesus) to scold naughty children and rap them with a stick. The straw costume is sewn on to the wearer.



BULGARIA On New Year's Day men cover themselves with goatskins to impersonate the Kukeri, who both embody and chase away evil spirits. In the past they'd brush against women to bestow fertility.

SPAIN Juantramposo, a mischief-maker, appears on Mardi Gras in Alsasua. The festival ends with all the participants taking part in a celebratory dance.

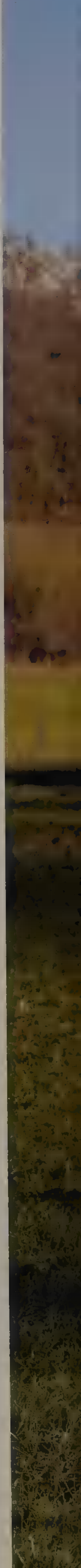
dancers. In Sardinia, Italy, goats, deer, boars, or bears may play the sacrificial role. Throughout Austria, Krampus, the beastly counterpart to St. Nicholas, frightens naughty children.

But everywhere there is the wild man. In France, he is l'Homme Sauvage; in Germany, Wilder Mann; in Poland, Macidula is the clownish version. He dresses in animal skins or lichen or straw or tree branches. Half man and half beast, the wild man stands in for the complicated relationship that human communities, especially rural ones, have with nature.

The bear is the wild man's close counterpart—in some legends the bear is his father. A beast that walks upright, the bear also hibernates in winter. The symbolic death and rebirth of hibernation herald the arrival of spring with all its plenty. For festival participants, says Fréger, "becoming a bear is a way to express the beast and a way to control the beast."

Traditionally the festivals are also a rite of passage for young men. Dressing in the garb of a bear or wild man is a way of "showing your power," says Fréger. Heavy bells hang from many costumes to signal virility.

The question is whether Europeans—civilized Europeans—believe that these rituals must be observed in order for the land, the livestock, and the people to be fertile. Do they really believe that costumes and rituals have the power to banish evil and end winter? "They all know they shouldn't believe it," says Gerald Creed, who has studied mask traditions in Bulgaria. Modern life tells them not to. But they remain open to the possibility that the old ways run deep. *—Rachel Hartigan Shea*



MAHOGANY'S LAST STAND

Illegal logging has all but wiped out Peru's mahogany. Loggers are turning their chain saws on lesser known species critical to the health of the rain forest.

A mahogany sculpture in a park in the timber hub of Pucallpa symbolizes the tree's importance.

By Scott Wallace

Photographs by Alex Webb

Mahogany is the crown jewel of the Amazon, soaring in magnificent buttressed columns high into the forest canopy. Its rich, red grain and durability make it one of the most coveted building materials on Earth, favored by master craftsmen, a symbol of wealth and power. A single tree can fetch tens of thousands of dollars on the international market by the time its finished wood reaches showroom floors in the United States or Europe.

After 2001, the year Brazil declared a moratorium on logging big-leaf mahogany, Peru emerged as one of the world's largest suppliers. The rush for "red gold," as mahogany is sometimes called, has left many of Peru's watersheds—such as the Alto Tamaya, homeland of a group of Ashéninka Indians—stripped of their most valuable trees. The last stands of mahogany, as well as Spanish cedar, are now nearly all restricted to Indian lands, national parks, and territorial reserves set aside to protect isolated tribes.

As a result, loggers are now taking aim at other canopy giants few of us have ever heard of—*copaiba, ishpingo, shihuahuaco, capirona*—which are finding their way into our homes as bedroom sets, cabinets, flooring, and patio decks. These lesser known varieties have even fewer protections than the more charismatic, pricier ones, like mahogany, but they're often more crucial to forest ecosystems. As loggers move down the list from one species to the next, they're cutting more trees to make up for diminishing returns, threatening critical habitats in the process. Primates, birds, and amphibians that make their homes in the upper stories of the forest are at increasing risk. Indigenous communities are in turmoil, divided between those favoring conservation and those looking for fast cash. And some of the world's most isolated tribes are in flight from the whine of chain saws and the terrifying crash of centuries-old leviathans hitting the ground.

Illicit practices are believed to account for three-fourths of the annual Peruvian timber harvest. Despite a crackdown on mahogany logging that began five years ago and a sharp decline in production, much of the timber reaching markets in the industrialized world is reported to be of illegal origin. Most of those exports have gone to the U.S. but are now increasingly bound for Asia.

An agent from Peru's park service hand-measures the width of a section of an illegally cut mahogany. A logger with a chain saw can topple a centuries-old tree like this behemoth in less than half an hour.

A SHORT DISTANCE southeast of the Alto Tamaya, a 15,000-square-mile mosaic of protected areas known as the Purús Conservation Complex teems with gigantic trees that first sprouted from the jungle floor centuries ago. This region embraces the headwaters of the Purús and Yurúa Rivers, and tribes living in extreme isolation maintain a presence in its rugged upland folds. It is also believed to hold as much as 80 percent of Peru's remaining big-leaf mahogany.

Illegal loggers are using surrounding Indian settlements as a back door into the protected lands. Many communities have been tricked by men offering cash for help in obtaining logging permits, which they later use to launder mahogany illegally cut inside the reserves. Along the Huacapistea River, a Yurúa tributary that forms the northwestern border of the Murunahua Territorial Reserve, duplicitous dealings have left half a dozen Ashéninka communities impoverished and disillusioned.

At the height of the rainy season I join Chris Fagan, executive director of the U.S.-based Upper Amazon Conservancy, and Arsenio Calle, director of Alto Purús National Park, on a foray

“Welcome to the land without law,” Chota says, with a sweep of the arm. “The only law is the law of the gun.”

up the Huacapistea River. Boyish in his oversize khaki fatigues, Calle, 47, has jurisdiction over much of the Purús Complex. “Arsenio has done a remarkable job removing loggers from the park,” Fagan says. “But there is still strong demand for illegal mahogany.” Fagan’s organization created a Peruvian sister group called ProPurús to help the park service and indigenous federations protect the forests. One initiative involves organizing community “vigilance committees” to patrol around the edge of the national park and keep intruders out. ProPurús field director José Borgo Vásquez, a crafty 60-year-old veteran of conservation struggles throughout the Peruvian Amazon, is also aboard one of our motor-powered dugouts.

“The loggers are stealing from you and getting away with it,” Borgo tells a gathering at our first stop, the Ashéninka village of Dulce Gloria. “Why? Because you are doing nothing to stop them.” Borgo believes that conservation efforts will succeed only if local communities take an active role in the defense of their native lands. Two major obstacles, he says, are poverty and lack of education, which make the lure of cash so seductive and the need to protect the forest so difficult for many villagers to understand.

A third obstacle is distance, which gives timber poachers an overwhelming advantage. The Amazon rain forest is so vast and its far-flung river valleys so remote that it is impossible to patrol everywhere effectively. The absence of authority on the ground has given rise to a sense among loggers that the forest is theirs for the taking.

A local informant tells us that a logger named Rubén Campos is using an illegal track farther upriver to drag mahogany logs over the divide to an adjacent watershed. (Efforts to reach Campos for comment were unsuccessful.) Such a move would allow him to float any ill-gotten timber down to the Ucayali River and on to sawmills in Pucallpa, the regional capital, without the Ashéninka on the Huacapistea even knowing what he’s taking.

The next day, in a downpour, local guides lead us deep into the forest in search of the illicit operation. We pass a giant mahogany tree, an X etched in its bark, apparently slated for cutting. Anchored by sprawling buttress roots, the great trunk rockets into the canopy, where its branches drip with orchids and bromeliads. A gash in the forest leads into the rain-soaked jungle and vanishes in a blur of electric green. We soon find the culprit—a John Deere skidder with outsize tires parked in a shed made from rusted sheets of corrugated metal. We press on, passing a dozen massive mahogany and Spanish cedar trunks awaiting removal by the skidder. Calle measures their diameter—about five feet each. He says the trees are hundreds of years old.

We reach a clearing dominated by a shaggy thatched shelter. It’s guarded by a lone watchman, a specter of a man named Emilio, rousted from his hammock by our approach. “A man needs to work,” he says defensively. “If there’s no other work, what can one do?” It’s a question that vexes Calle as well. This logging operation is clearly beyond the bounds of legality; no one is authorized to cut this forest. But the camp itself is beyond Calle’s legal reach.

Given the torrential downpour, it would be too difficult to follow the skidder path across the rain-swollen creek and into the reserve, so we turn back. Calle will alert authorities once he gets back to Pucallpa, but no one is likely to have the stomach for charging or prosecuting anyone. Without hard evidence from inside the reserve, it would be a tough case to pursue. Loggers are apt to be well connected to power brokers in Pucallpa. Honest

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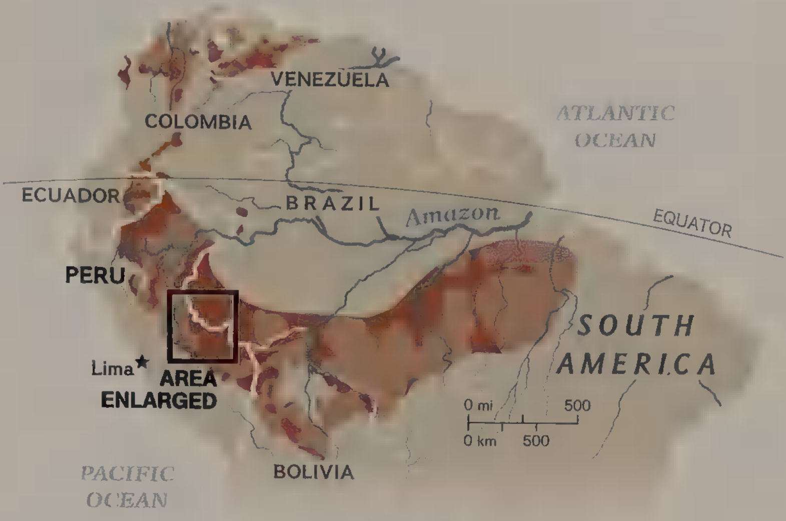
Scott Wallace reported on Ecuador’s Yasuní National Park in January. Alex Webb photographed our August 2012 story about East London.

Red Gold Rush

Peru is one of the largest suppliers of big-leaf mahogany, among the world's most vulnerable hardwoods. Requiring just the right combination of soil, moisture, and sunlight, the tree occurs from Mexico through Central America to the southern rim of the Amazon Basin. Logging has reduced mahogany to 30 percent of its historic range in South America.


VENEZUELA
COLOMBIA
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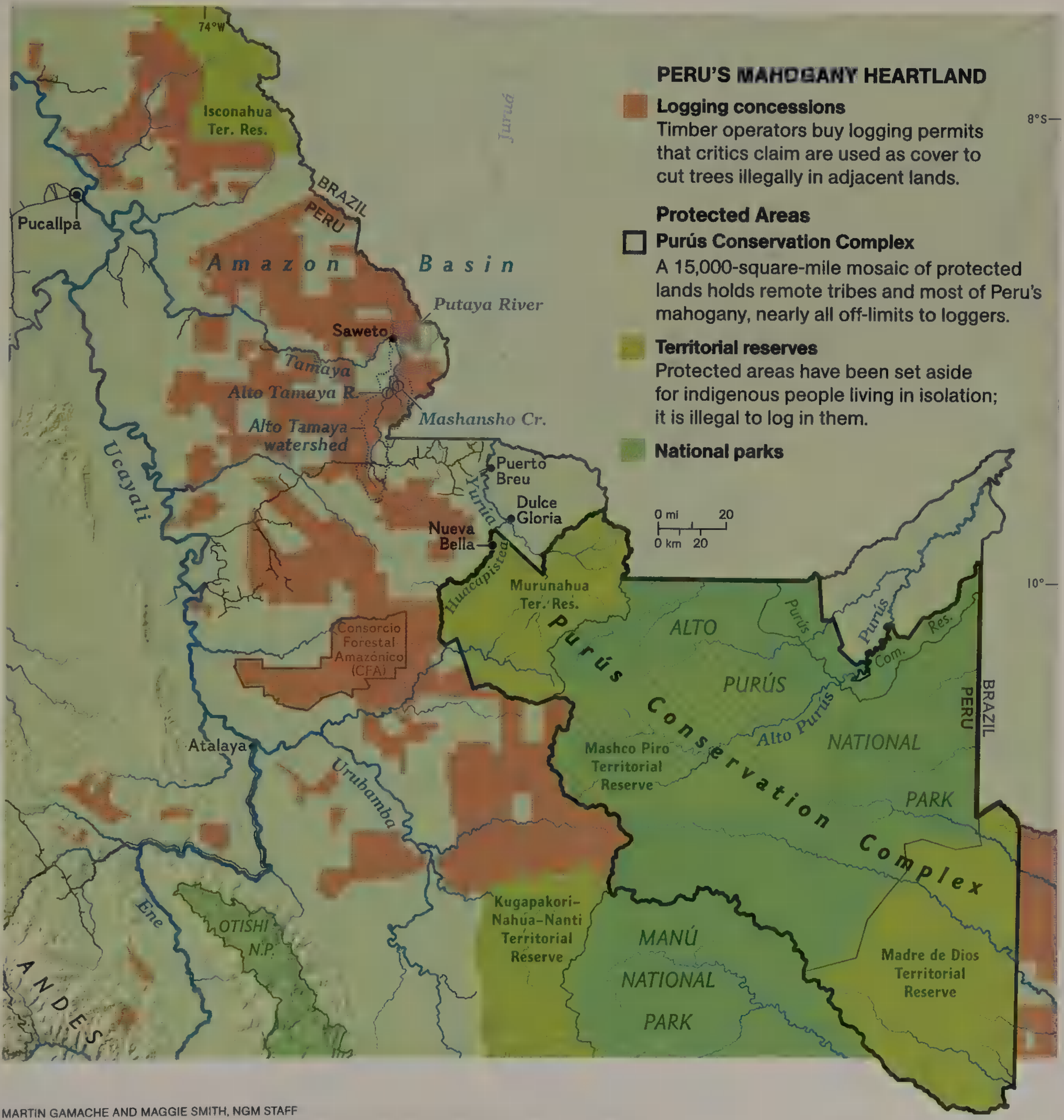
PACIFIC OCEAN
BOLIVIA

MAHOGANY RANGE

▨ Historic ■ Current

Only South American portion shown


74°W
Isconahua Ter. Res.
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BRAZIL
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Pucallpa
Amazon Basin
Putaya River
Saweto
Tamaya
Alto Tamaya R.
Alto Tamaya watershed
Mashansho Cr.
Ucayali
Puerto Breu
Yuruia
Dulce Gloria
Nueva Bella
Huacapistea
Murunahua Ter. Res.
Purús Conservation Complex
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PERU'S MAHOGANY HEARTLAND

🟧 **Logging concessions**
Timber operators buy logging permits that critics claim are used as cover to cut trees illegally in adjacent lands.

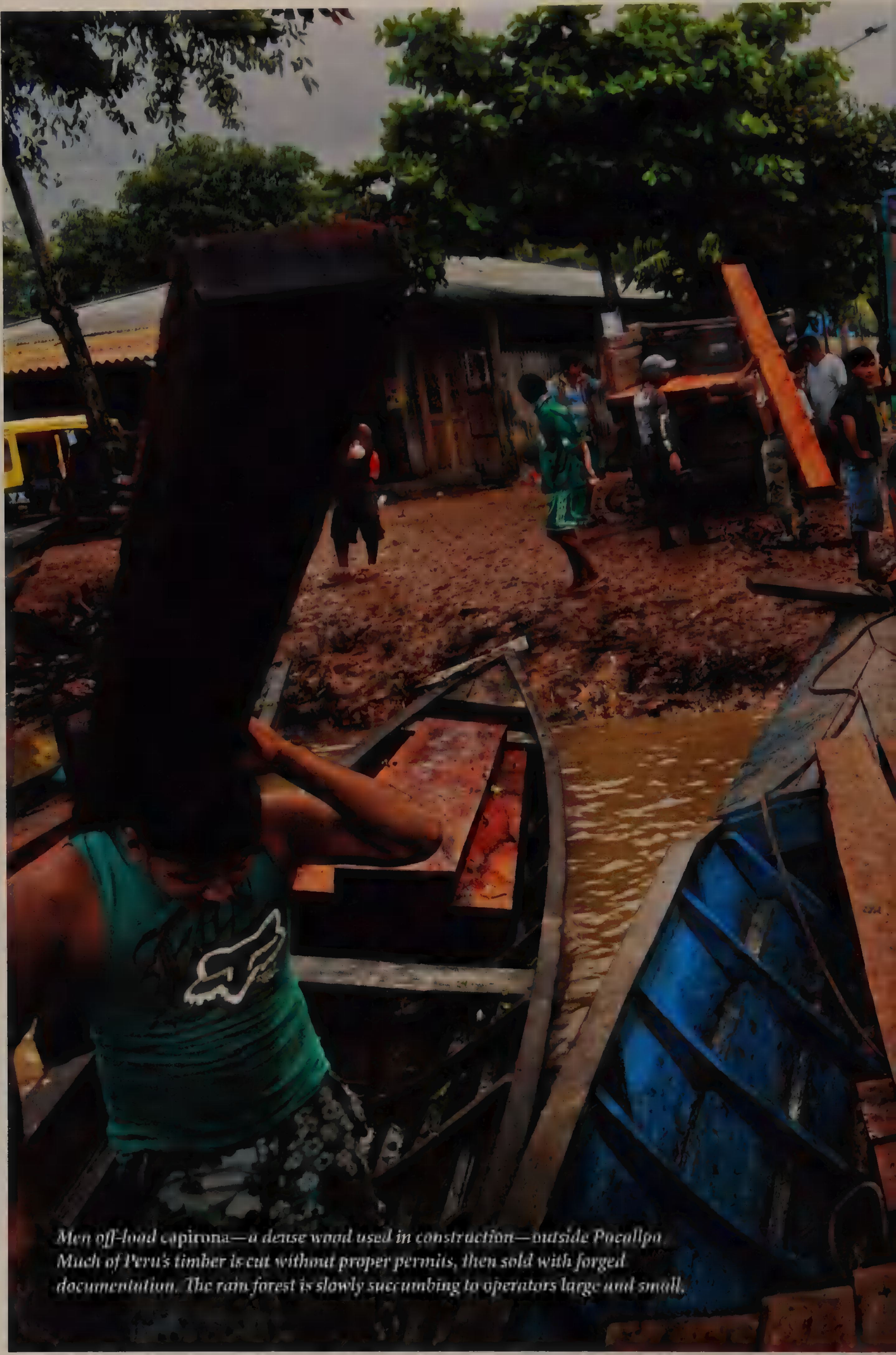
Protected Areas

☐ **Purús Conservation Complex**
A 15,000-square-mile mosaic of protected lands holds remote tribes and most of Peru's mahogany, nearly all off-limits to loggers.

🟨 **Territorial reserves**
Protected areas have been set aside for indigenous people living in isolation; it is illegal to log in them.

🟩 **National parks**

MARTIN GAMACHE AND MAGGIE SMITH, NGM STAFF
SOURCES: SPATIAL ANALYSIS LAB, UNIVERSITY OF RICHMOND; CHRIS FAGAN, UPPER AMAZON CONSERVANCY; JAMES GROGAN, INSTITUTO FLORESTA TROPICAL; INSTITUTO DEL BIEN COMÚN



Men off-load capirona—a dense wood used in construction—outside Pucallpa. Much of Peru's timber is cut without proper permits, then sold with forged documentation. The rain forest is slowly succumbing to operators large and small.

Amahuaca women and children gather in their remote settlement of Nueva Bella. Unscrupulous loggers target such communities, taking their timber at rock-bottom prices and stealing mahogany from nearby reserves that protect isolated tribes.

Timber mafias have already snatched mahogany for pennies on the dollar, if they paid anything for it at all.

cops often face smear campaigns, even outright dismissal, if they overstep boundaries. What's more, the government in Lima recently shifted forest enforcement responsibilities back to the regional governments, where officials are often more susceptible to arm-twisting. "The protected areas are going to be reduced to fragmented forest if we don't take a more proactive approach," says Calle, who fears loggers will now have even more latitude to undermine the rule of law.

THE BAD GUYS won't have any freedom at all in Edwin Chota Valera's territory, not if he can help it. Chota—a sinewy, 52-year-old firebrand with rakish, jet-black hair and a hawk's beak of a nose—is the leader of the Ashéninka village of Saweto, some 60 miles northwest of the Purús Conservation Complex. Since 1998, when local Ashéninka established Saweto, they have stood by helplessly as, season after season, logging crews floated colossal trunks downriver from the headwaters of the Alto Tamaya and Putaya Rivers to sawmills in Pucallpa.

In the face of these trespasses, a decade ago villagers undertook a quest to get the regional government in Pucallpa to grant them legal title to their land—more than 250 square miles of river-laced forest stretching from Saweto all the way to the Brazilian frontier. Their claim was ensnared for years in red tape, while poachers pillaged their forests. It appears their petition may finally be resolved later this year.

The illegal logging epidemic prompted U.S. lawmakers in 2007 to require a series of reforms as a condition for approving a free-trade agreement with Peru. The agreement committed Peru, among other things, to implement a plan of action on big-leaf mahogany that would comply with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Officials in Lima say they are experimenting with other measures, including an electronic monitoring system, that will help modernize Peru's timber industry. Changes have been slow to take effect and have brought little relief for many remote communities like Saweto, victims of timber mafias that have already snatched their mahogany for pennies on the dollar, if they paid anything for it at all.

But this is a new era for the Ashéninka of the Alto Tamaya. At a meeting in Saweto's one-room schoolhouse, a woman named Teresa López

A park service guard (at left) and an Ashéninka guide size up an old-growth mahogany, highly valuable to criminal loggers. Because individual trees can't be protected, this giant is almost certainly doomed.

Campos urges her people to stand up to the loggers. "Where are we going to go if they drive us away from here?" she says vehemently. "This is where we will die. We have nowhere else to go."

Two days later ten or so Ashéninka men and women have come together under Chota's direction to follow illegal loggers into the headwaters of the Alto Tamaya and demand their departure. Since dawn we've been following the twists and turns of the emerald green Mashansho Creek through dense jungle along Peru's eastern border with Brazil. Poling dugouts through sand-rippled shallows, pausing to spear catfish in crystalline eddies, my Ashéninka hosts are biding their time, confident that somewhere upstream we'll confront a band commanded by an elusive man they call El Gato—the Cat. The expedition is fraught with risk, likely to incur the wrath not only of the loggers but also of their paymasters in Pucallpa—the sawmill owners and timber brokers, who are closely connected to the city's power elite.

The men of Saweto were away when El Gato motored upstream past the village a week earlier. Ignoring shouts from the women on the embankment to stay out of their forests upriver, The Amazon rain forest is so vast and its valleys so remote that it is impossible to patrol effectively everywhere.

El Gato kept right on going, his three boats piled high with enough food and fuel to keep his sullen-faced crew cutting trees in the backwoods all summer long.

"As long as we don't have title, the loggers don't respect native ownership," Chota says, standing at the rear of the canoe, propelling us with thrusts of a ten-foot pole. "They threaten us. They intimidate. They have the guns." The target of frequent death threats, Chota has repeatedly been forced to seek sanctuary among the Ashéninka's tribal relatives in Brazil, a two-day hike from here along ancient footpaths.

"Titling is a critical ingredient in the fight against illegal logging," agrees David Salisbury, a University of Richmond geographer who's sitting beside me. The lanky, fair-haired Salisbury has served as the villagers' adviser since he first learned of their plight while doing doctoral research in 2004. "The native communities are the ones most invested in their place," he says. "They're the most capable of making long-term decisions about how to use their homeland and resources in a sustainable way."

PERU'S LOGGING INDUSTRY operates within a framework of concessions and permits designed to allow a community, company, or individual to extract a sustainable yield from a given area. Transport permits are also issued to track the chain of custody of a shipment from stump to sawmill and on to the point of export or final sale. But permits are easily traded on the black market, enabling loggers to cut timber in one place and say it came from somewhere else.

The Alto Tamaya area offers a case in point. The government's nearest inspection station is several days downriver from Saweto, Chota tells me. So when it comes time for El Gato to float his logs out during next year's rainy season, he can claim that any timber he illegally cut in Ashéninka territory was harvested on a legitimate concession nearby. "Welcome to the land without law," Chota says, with a sweep of the arm. "From that inspection post all the way back here, there is no law. The only law is the law of the gun."

As we pole our way up Mashansho Creek, it becomes clear that outsiders are not the only ones pillaging the forest. We disembark on a beach where the high-pitched whine of a motor reaches us from back in the woods. Minutes later we come upon five young men, shirtless and barefoot, in the midst of toppling a massive copaiba tree. They're all Ashéninka, all relatives of our party's eldest member, "Gaitán" (not his real name). Amid a blizzard of sawdust and flying debris, Gaitán's son cuts deep into the trunk. Suddenly it cracks like a thunderbolt. Everyone dashes for cover, the saw still purring as the behemoth starts a free fall and lands with an earthshaking thump.

Pungent, pine-scented sap oozes from the fresh stump. The oil is renowned for its curative properties, and left standing, the tree could have fetched far more over the years for its medicinal oil than the onetime cash payout—probably less than a hundred dollars—that Gaitán's family will get for its timber. But with El Gato's crew on the loose in these woodlands, these men decided to lay claim to it first. Such are the distortions created by the absence of law; in this jungle free-for-all, it's finders keepers.

Chota shakes his head in disgust at the sight of the copaiba stump. "Everyone who logs here is illegal, period," he says. "No one has the proper permits." Chota has been trying to wean the Ashéninka away from such destruction. But he must tread lightly or risk further dividing his people. Native communities can subsist on game, fish, and crops if their forests are intact. Still, they need things like clothes, soap, and medicine, and for many, logging—or taking handouts to let loggers in—is the only way to acquire those goods.

As the sun drops low, painting the treetops in splashes of yellow light, the team decides it's time to leave the canoes behind and cut a straight line on foot through the jungle. The shortcut will put us upstream of El Gato. Trudging through dank forest as the last rays of sun fade from the sky, we ford the winding creek for a third time and look for a place to camp for the night.

BECAUSE PERMITS are commonly used to launder wood taken from adjacent lands, Peru's concession system has been widely criticized for providing cover for illegal logging. But the forestry engineers and harvesters with a company called the Consorcio Forestal Amazónico (CFA) say they are trying to do things right. CFA operates a huge concession in the dense woodlands astride the Ucayali River in the heart of the Peruvian Amazon. The enterprise is the very model of rational exploitation, with fluorescent-vested saw operators guided to their targets by computerized maps and databases. Its 455,000 acres of primal forest have been divided into a grid of 30 parcels, each corresponding to a single year's harvest in a 30-year rotation plan.

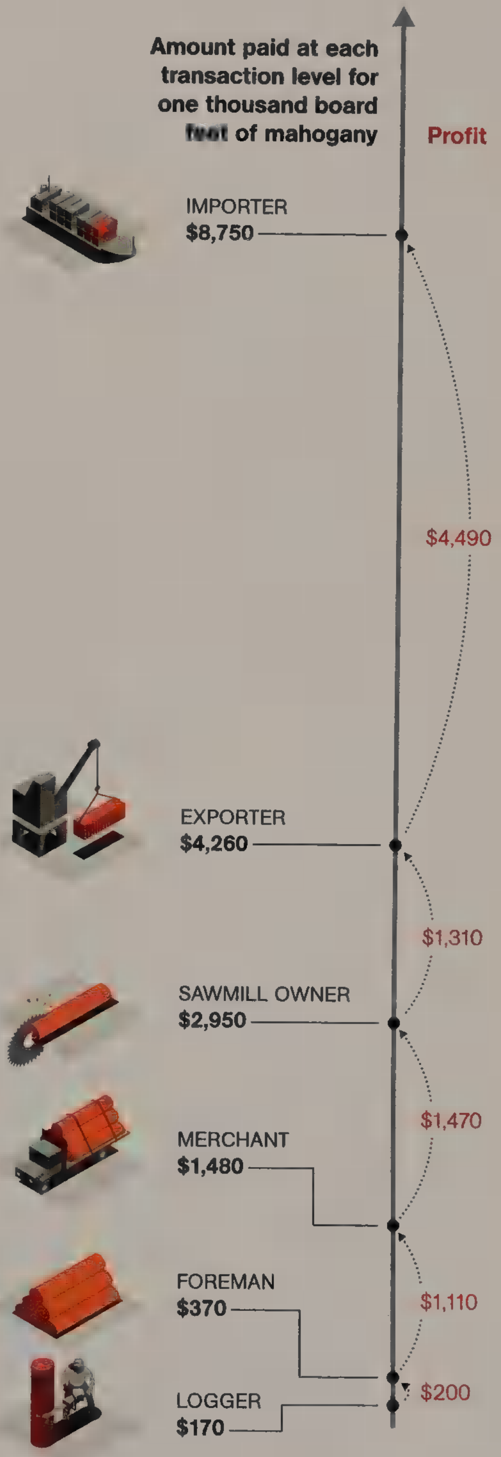
At a base deep inside the concession, supervisors consult with crews to plan the day's work. "Delineators" crouch over drafting tables, updating computerized maps that crews will take into the forest. Every harvestable tree is color-coded by species and identified by number. Each two-man crew will cut approximately ten trees by sundown, working a line through the forest that matches a strip of the larger map. Seed-bearing adult trees, which will be left standing to regenerate the woodland, are also identified.

"We try to leave the forest cover as undisturbed as possible," says Geoffrey Venegas, a Costa Rican forestry engineer who oversees the cutting. "We're light-years ahead of what I've seen elsewhere."

We clamber out of a pickup truck at an acre-size collection point fringed with piles of freshly cut logs, three to four feet in diameter, from trees with unfamiliar names: *chamisa*, *yacushapana*, and the aromatic *alcanfor moena*. There's hardly any mahogany in CFA's concession. For Venegas,

PROFIT AND LOSS

Over the past decade most of the mahogany officially exported from Peru went to the U.S. Profits from the timber trade benefit primarily the exporters and importers. Little money goes to the indigenous communities, whose lands and rights are often abused in the process.



FIGURES REPRESENT PRICING FOR HIGH-GRADE MAHOGANY, BASED ON RESEARCH FROM 2008 AND 2011.
GRAPHIC: MARTIN GAMACHE, NGM STAFF; ÁLVARO VALIÑO. SOURCE: ENVIRONMENTAL INVESTIGATION AGENCY

As early morning mist hangs over the Alto Tamaya River, Ashéninka Indians from the community of Saweto prepare for a journey upstream to confront a band of illegal loggers. For years their forests have been plundered for choice timber. Now they've decided to act.

ELMO

A kapok log dangles from a crane on the Ucayali River outside Pucallpa. Soaring giants draped with orchids, kapok trees provide rich habitat for primates, birds, amphibians, and insects. They're also in high demand for pulp and plywood.

the future of tropical hardwoods lies with these less glamorous trees. "We've identified 20 different species with commercial potential," he says. "This year we're cutting 12 of them."

CFA executives say that making use of multiple species increases the value of the forest, providing a greater incentive to take care of it, even if mahogany and Spanish cedar have already been logged out. "Socially responsible" investors are impressed with the company's practices, its potential for long-term profits, and its certification from the Forest Stewardship Council, an international third-party auditing body that sets standards and recommendations for sustainable forestry.

But the impact of even these practices comes as a shock to a visitor to a forest that just weeks ago was an untouched wilderness. In the stillness of midmorning a screaming piha's cry resounds through the woods. An iridescent blue morpho butterfly the size of an outstretched hand flits past, like a kite jerking in the breeze. Monkeys play peekaboo from a stand of uncut trees. The dry season is already well along, but the forest floor remains spongy, exuding a damp vitality

What will this forest look like 30 years from now, when rutted roads extend into the far corners of the concession?

resistant to drought—the hallmark of a healthy tropical rain forest.

What will this forest look like 30 years from now, though, when rutted roads and feeder trails extend into the far corners of the concession, and when men and machines return here to begin the cycle anew? Will the forest have regenerated? CFA is banking on it. "If we're able to do it, the whole Peruvian timber industry will benefit," sales manager Rick Kellso says. "You can get a nice profit by doing things right. You don't have to be illegal."

BACK IN THE UPPER REACHES of Mashansho Creek, beneath a sky blazing with stars, Edwin Chota Valera and David Salisbury gather the Ashéninka around the campfire to plot tomorrow's showdown with El Gato. "He's going to ask to see your papers," Salisbury says, referring to the title the Ashéninka still do not have. "But remember, he has no papers either. He's logging here illegally. He has no justification for being here."

We enter the logging camp at first light, swarming the squalid huts before anyone has time to reach for a rifle. A fair-haired man in a yellow soccer jersey rises to his feet. His green eyes betray bewilderment.

"Are you the man they call El Gato?" Chota asks.

"I am," the man says warily. Without putting up a fight, he agrees to leave but pleads with the Ashéninka for permission to take out the trees he's already cut upstream. "We're just working people trying to put food on the table." There's a ring of defeat in his voice. He says he's mired in debt to a man named Gutiérrez, who fronted $50,000 cash for the logging expedition. "That guy will hound me until the day I die," he says.

Chota is unmoved. "Things could turn bad for you if you stay up here," he warns. The government in Lima, Chota tells him, has promised indigenous communities a greater voice in their own affairs. "Things are beginning to turn in our favor."

But within days of our encounter with El Gato, vandals steal into Saweto under cover of darkness and sabotage three outboard motors that were used by Chota's party, a devastating blow to the impoverished community. The Ashéninka have little doubt who did it. Prosecuting the crime will be another matter entirely. ☐

NG CONNECT

Every month this page features our staff picks of National Geographic Society products and events. For more go to *nglive.org*.

NATIONAL GEOGRAPHIC ON TV

The 80s: The Decade That Made Us

Whether it's Ronald Reagan or Rubik's Cube, symbols of the 1980s call to mind a time of cultural fads, technological advances, and economic change. This month the National Geographic Channel celebrates this influential decade in a new series, featuring interviews with icons from Jane Fonda to Ted Turner to Grandmaster Flash.

EXPEDITIONS

TO THE ENDS OF THE EARTH National Geographic's Arctic and Antarctic ship expeditions put the polar realms within reach, providing opportunities for exploring icy landscapes by foot, kayak, and Zodiac. Head north to Svalbard, the land of polar bears, icebergs, and the midnight sun. Or set your sights southward to Antarctica, South Georgia, and the Falkland Islands, where penguins and seals await. View the itineraries at *ngexpeditions.com/polar.*

LECTURE

IN SEARCH OF THE ANCIENT MAYA National Geographic grantee William Saturno has spent more than ten years working in Central America, where he's made groundbreaking archaeological discoveries about the ancient Maya civilization. Hear Saturno's lively account of this enigmatic Mesoamerican culture and catch up on his recent finds from the field. For details go to *nglive.org*.

APP

NATIONAL GEOGRAPHIC BIRDS This comprehensive field guide to North American birds has illustrations for 995 species and offers audio for many of them. Birders can make field notes, take quizzes, watch videos, and get news from the birding world. Available for iPhone and iPad in the App Store today.

EXHIBIT

GARDENS AT NIGHT Diane Cook and Len Jenshel photographed moonlit gardens for the March issue; now their work is on display at the National Geographic Museum in Washington, D.C. Visit *ngmuseum.org*.

BOOK

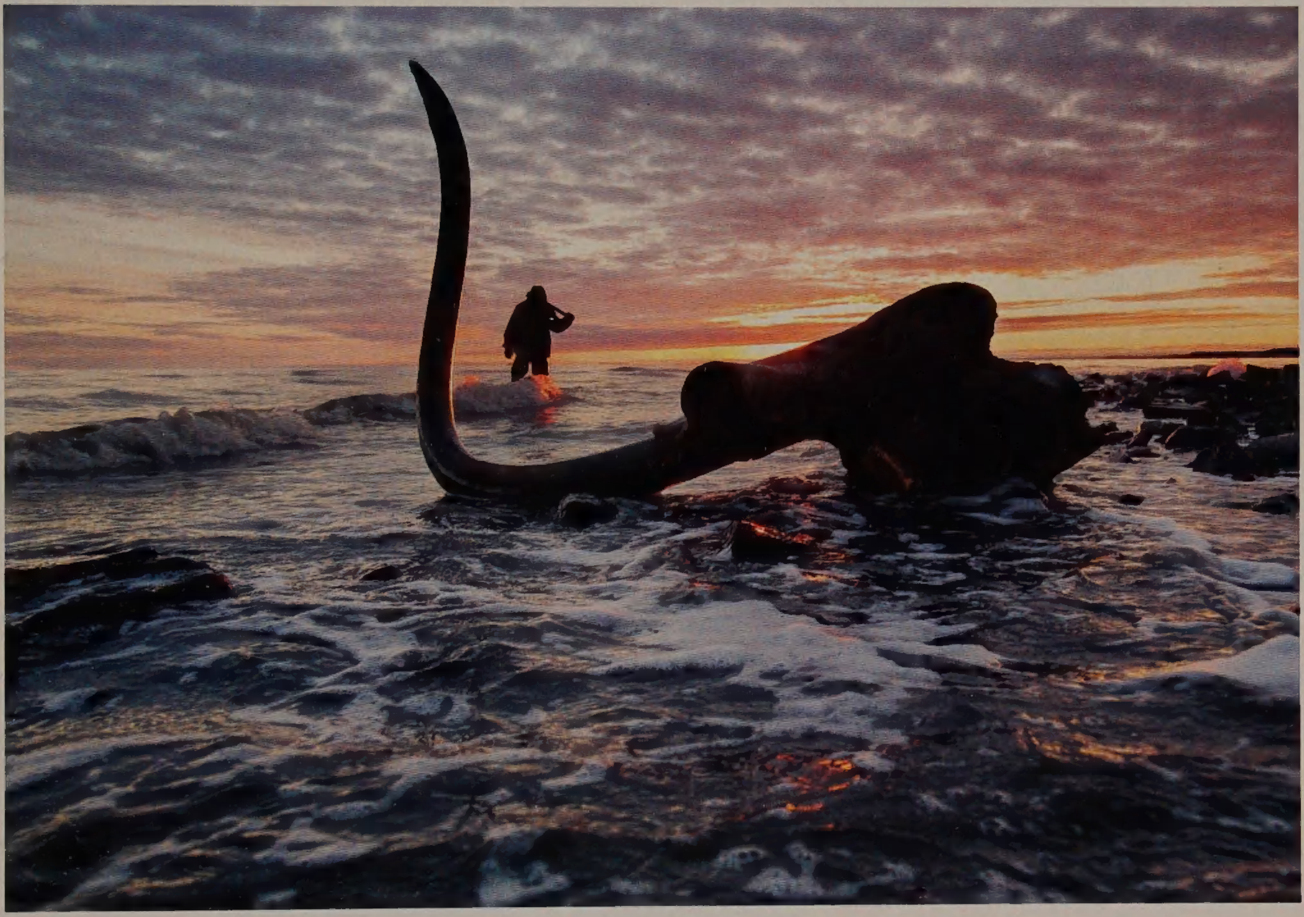
SECRETS OF THE NATIONAL PARKS There's more to the national parks than the obvious tourist destinations. This guide is packed with tips for helping you go beyond the beaten path. On sale April 2 ($22.95).

Secrets of the National Parks

PHOTOS: JASON VERSCHOOR, GETTY IMAGES (TOP); TYRONE TURNER

Tusk and Sunset

A mammoth's tusk spikes the Siberian sky on Bolshoy Lyakhovskiy Island. Tusks that are discovered with the mammoth's skull still attached, like this one, are not considered more valuable, notes photographer Evgenia Arbugaeva. She spent two months on the island to document the hunt for ancient ivory. "They can't sell the skull," she says of the tusk hunters. "There is no need to saw off the tusk from the skull. They just pull it out, like pulling out a tooth." *—Margaret G. Zackowitz*



BEHIND THE LENS

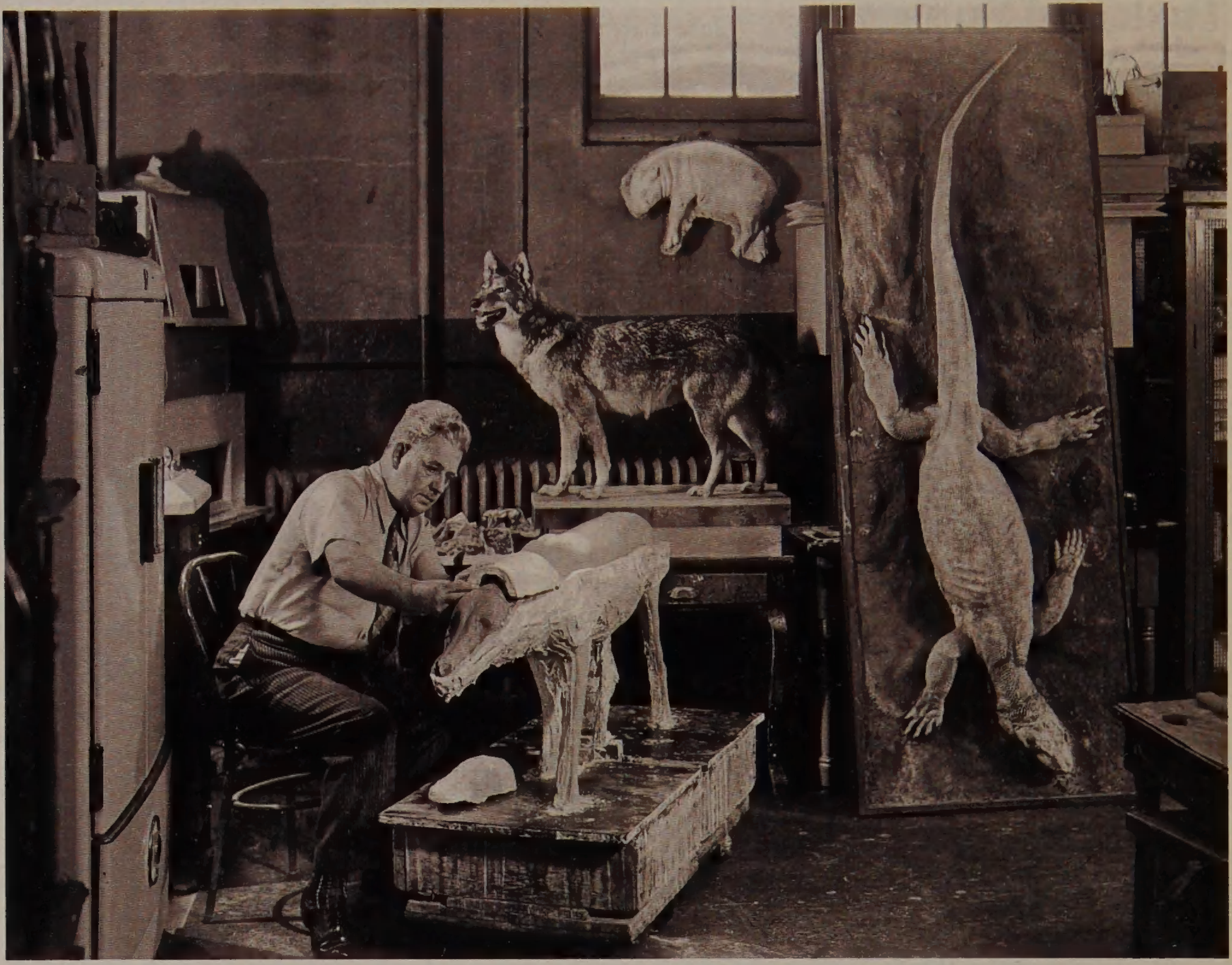
You are originally from Siberia. Did you grow up close to where you photographed these tusk hunters?

EA: I am from a town called Tiksi, not so far from where we were. People found mammoth tusks by accident near where I grew up. When I was young, I read a novel—there was a movie too—about a place called Sannikov Land. In the story some Arctic explorers went in search of this island, a myth, that was a tropical place. It was supposed to have mammoths. Its location was near the New Siberian Islands, where we were.

The weather in your photos doesn't look so tropical.

It was not very bad! We were there in summer, July and August, so the temperatures were about 8°C [46°F] during the day, minus 10°C [14°F] at night. There was not so much rain, just fog. Because the landscape there is very minimalist and simple, I was wishing for some weather, something different. During the whole time on the island we had polar day. It was light all the time. This picture was made close to the end of the season, when the sun started to set a little. We finally did get a sunset.

FLASHBACK



The Right Stuff One of William L. Brown's first assignments as a taxidermist was to preserve specimens that Teddy Roosevelt brought back from his 1909 expedition to Africa for the Smithsonian. In his 51-year career at the National Museum of Natural History in Washington, D.C., Brown worked on almost every imaginable kind of animal, including this timber wolf in 1947.

Some of Brown's work is still on display at the museum. Of his favorite piece—a hippo with a hide made supple through a Russian tanner's chewing—he wrote: "This was when I was best. 40 yrs old. As a taxidermist. I was the first person ever to mount a successful hippo and probably will be the last." The museum's most recent taxidermist, Paul Rhymer, said it was the best preserved animal he'd ever seen. *—Johnna Rizzo*

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PHOTO: B. ANTHONY STEWART, NATIONAL GEOGRAPHIC STOCK

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